

**PRESERVATION VALUES FOR VISIBILITY  
PROTECTION AT THE NATIONAL PARKS**

***Draft Final Report***

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## **DISCLAIMER**

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## **1.0 INTRODUCTION**

This document presents the design and results of a study conducted for the U.S. Environmental Protection Agency, the National Park Service, and the University of Colorado concerning the estimation of preservation values held by the general public for the protection of visibility at national parks from air pollution impacts.

### **1.1 BACKGROUND**

Under the Organic Act of 1916, the National Park Service (NPS) is charged with protecting the resources of areas under its jurisdiction to assure their continued availability for the enjoyment of the public. The fact that these areas have been set aside reveals a Congressional intent to preserve the resources, purposes, and values of these unique national treasures in perpetuity. These actions reveal a value for preserving the resources that goes well beyond the use of the resource in the current period and perhaps beyond future use as well.

Because of the increasing use of cost-benefit analysis in various decision-making processes, there is a need to develop methodologies that can be used to quantify the economic benefits associated with preserving park resources to assure that credible and useful information concerning how the public values these resources can be provided to decision-makers. The costs and benefits of alternative industrial development scenarios or regulatory approaches are routinely weighed by federal, state, and local agencies during certain decision-making processes. For example, the Clean Air Act allows regulatory and permitting agencies to consider costs and benefits before deciding whether to require installation of retrofit controls on existing stationary sources that are contributing to visibility impairment in Class I areas. Costs and benefits may also be weighed by permitting authorities in permitting decisions for new sources that may adversely affect a scenic vista, but not cause any adverse impact within park boundaries. Finally, the Environmental Protection Agency has recently suggested that the Clean Air Act might allow the Agency to consider costs and benefits when establishing secondary national ambient air quality standards. Secondary standards are designed to prevent "welfare" effects (e.g., adverse effects on visibility, soils, water, vegetation, etc.) and are, therefore, critical to assure protection of park resources.

In addition to the likelihood that costs and benefits of alternative actions will be considered in decisions made by others, regulatory actions initiated by the EPA and NPS are subject to the requirements of Executive Order 12291. The order requires that costs and benefits to society be weighed before new regulations are issued, that a regulation not be issued unless the potential benefits to society outweigh the costs, and that of the alternative

approaches to a given regulatory objective, an agency must select the alternative involving the least net cost to society. Even in cases where a statute explicitly excludes economic considerations from entering into a decision, a regulatory impact analysis must be performed for new major regulations. The regulatory impact analysis must include a discussion of the costs and benefits of alternative regulatory approaches.

Current estimation methods and empirical estimates of social benefits associated with preservation of natural area park resources, and visual air quality at these sites, other than for current period use, are quite limited. Analyses conducted for the Integral Vista Regulatory Impact Analysis (Chestnut and Rowe 1983) exemplified the limited information currently available for use in quantifying benefits of NPS resource protection, especially with regard to preservation benefits that extend beyond direct benefits to current park visitors. One study has extensively considered preservation values for visibility protection at national parks of the Southwest (Schulze et al. 1981); a few other studies have, in a limited way, addressed issues in this study (Wiley et al. 1986, Rahamatian 1986); and another only casually addressed the issue for one national park in the eastern U.S. (Rae 1984). These studies provide only limited evidence for visibility-related preservation values at a handful of national parks. Moreover, the accuracy of the results has been questioned as practitioners learn more about the design and application of the contingent valuation method used to obtain these results. The limited nature of the work done to date makes general application of findings vulnerable to criticism based on questionable transferability of results from one setting or issue to another. Because of the general lack of agreement on, or acceptance of, any preservation value estimate, federal, state, and local agencies may be forced to give less weight to potential social benefits in regulatory analysis.

For all of the above reasons, this study has been designed with the intention of advancing the state-of-the-art in estimation of preservation values and to produce additional empirical results that can be used to provide information to decision-makers who are authorized, if not required, to consider costs and benefits when making regulatory or permitting decisions affecting visual air quality in and around national parks. Therefore, the objective of the study is to attempt to establish a set of defensible benefit estimates for visibility protection for a variety of national parks with sufficient accuracy, reliability, and variety to be useful in answering broad national policy questions and in addressing specific issues on a case-by-case basis.

## **1.2 ORGANIZATION OF THE REPORT**

Chapter 2 provides background information on the concepts of visibility values and issues concerning the use of the contingent valuation method to obtain preservation values for visibility protection at national parks. Chapter 2 also reviews key literature covering previous empirical studies of preservation values for visibility protection at national parks, and other related preservation value studies.

Chapter 3 describes the design and implementation of a new contingent valuation method (CVM) mail survey used to obtain preservation value estimates for visibility protection in and around national parks of the Southwest, California, and the Southeast. Included in this chapter are discussions of how the various features are designed to minimize, test for, and correct selected potential biases in the CVM instrument.

Chapter 4 presents a detailed summary of results and their implications. Because the analysis is quite detailed and extensive, Chapter 5 presents a simple bulleted summary of the key findings, and discussions of the interpretation and use of the results. Chapter 5 also discusses potential future directions for the use of the CVM method in estimating preservation values for national park resources.

Sample mail and telephone survey instruments are found in the Appendices.

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## 2.0 ESTIMATING VALUES FOR PROTECTING VISIBILITY AT NATIONAL PARKS

This chapter introduces the concepts and measures of value for changes in non-market natural resources that have been developed in the economics literature, and briefly discusses key issues in the contingent valuation method (CVM), which is used in this study. The second section of this chapter summarizes the results of previous studies that have estimated values for changes in visibility at national parks, and discusses selected related literature concerning estimation of preservation values for natural resources.

### 2.1 CONCEPTS OF VALUE

Before talking about the “value of visibility” at national parks, it is important to define what is meant by this in the economics literature. The accepted economic measure of the dollar value to an individual for a change in the quantity or quality of any good or service is the change in income that would cause the same (or offsetting) change in the individual's well-being (utility) as a specified change in the good or service. This measure is commonly referred to as “consumer's surplus.”<sup>1</sup> Thus, the information desired for this benefit analysis is the change in income, for all affected parties, that would cause the same (or offsetting) change in utility as the change in visibility that is being considered.

For environmental public goods that are not exchanged in a market, there are two ways traditionally used to define this change in income:

- Willingness to pay (WTP) is the maximum dollar amount the individual is willing to pay to obtain an increase, or prevent a decrease, in the quantity or quality of the good.
- Willingness to accept compensation (WTA) is the minimum dollar amount the individual is willing to accept to voluntarily forgo an increase, or to accept a decrease, in the quantity or quality of the good.

One important distinction that has been drawn in the literature is that some value is related to one's own use of the resource, while some value may not be related to one's own use. Use values for visibility at national parks are the values associated with the park's visual air quality during an individual's own on-site visits to a park and through off-site enjoyment of park features with films, photographs, paintings, etc. Non-use values for visibility at national parks are values the individual may have for protecting visibility unrelated to his or her own use, which may be held even if he or she never visits the parks.

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<sup>1</sup> See Freeman (1979), Just et al. (1982), Morey (1984), Vartia (1983), and Randall and Stoll (1980) for more rigorous definitions and discussion of welfare value measures for environmental goods based on standard economic utility theory, and see Rowe and Chestnut (1982) for a discussion of this theory specifically related to visibility.

The concept of non-use value for natural resources was first elucidated by Krutilla (1967) who observed that “there are many persons who obtain satisfaction from mere knowledge that part of wilderness North America remains even though they would be appalled by the prospect of being exposed to it.” The concepts of use and non-use values for natural resources have received considerable attention in the economics literature and more rigorous definitions of use and non-use values have been developed since Krutilla first introduced the concept in the resource economics literature. Important contributions to this literature have been made by Krutilla and Fisher (1975), Randall and Stoll (1983), McConnell (1983) Freeman (1988), Cicchetti and Freeman (1971), Krutilla et al. (1972), Freeman (1984) and others. Several different categories of, and nomenclature for, use and non-use values have been developed in this literature, including (but not limited to) the following. These terms are used in this report as defined here, but may be used somewhat differently by other authors.

- Option price. Option price is a measure of use value that reflects uncertainty regarding future use of a resource. It equals the expected value of impacts upon current and future use plus a risk premium, which may be positive, negative, or zero. The risk premium is related to uncertainty regarding desired future use and the impact of the resource change upon future use, and its sign (positive or negative) depends on whether the individual prefers to err toward preserving a resource that may not be wanted for use in the future, or toward losing a resource that may be wanted for use in the future.
- Bequest value. This is the component of non-use value that is related to the use of the resource by others now and in the future. This value is typically thought of as altruistic in nature.
- Existence value. This is the component of non-use value that is related to preservation of the resource, even if there is no human use of the resource in the traditional sense. In practice, bequest and existence values are difficult to distinguish and are often together referred to as existence value.
- Preservation value. This term refers to the total value of a resource and includes all use and non-use values.

While much of this literature has focused on whether or not a particular natural resource, such as an endangered species, is to be preserved, the same value categories apply to changes in the quality of a resource (Freeman 1988). With visual air quality at national parks, the issue is typically at what level it is to be maintained, not whether or not it will exist at all.

Option price differs from on-site use value because it is an ex ante measure based on expected use rather than an ex post measure of value based on actual use, and includes a risk aversion premium. As the ex ante measure, option price is the appropriate measure for analysis of proposed regulatory decisions that may affect the quality or availability of the future use of a resource (Chavas et al. 1986).

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## 2.2 THE CONTINGENT VALUATION ESTIMATION METHOD

### 2.2.1 Why the Method is Selected

For private market goods, WTP and WTA measures of value can be derived from market information on prices and quantities of the goods sold. For non-market goods such as environmental quality, this direct market information is not available and other methods must be used to estimate these measures of value.

Contingent valuation methods and travel cost/time allocation methods are potentially useful for estimating on-site use values related to visibility at national parks, although only the contingent valuation methods have been applied to date to obtain dollar estimates of these types of visibility-related on-site use values. The contingent valuation methods are the only methods available at this time for estimating non-use values, because these values are not expected to be revealed in observable market behavior, which is used as the basis for most other value estimation methods to value changes in non-market goods.

The contingent valuation method (CVM) involves the use of survey instruments to obtain information on the values respondents believe they would place on potential changes described to them in the survey. Variations of the CVM method include direct WTP or WTA questions, referendum questions, and contingent ranking questions. In this report we highlight key issues in applying CVM for estimating preservation values for visibility at national parks. Thorough reviews of CVM as applied to non-market resource and visibility valuation are available elsewhere (See Mitchell and Carson 1989; Rowe and Chestnut 1982; Cummings et al. 1986; Freeman 1988; Fischhoff and Furby 1988).

### 2.2.2 Accuracy and Reliability of CVM Responses

CVM is a developing empirical method and the credibility and reliability of the results have been the subject of some controversy in the economics profession. The skepticism results primarily from the hypothetical nature of the method. It is based on what people say, not necessarily on what they would actually do. Several potential sources of inaccuracy in implementing CVM include:

1. Failed Correspondence Between Theory and Method. While the underlying theory may correctly define the value measures of interest, the method chosen to implement the theory may not be designed to obtain the correct measure.
2. Failed Correspondence Between Method and Questionnaire. The method may be appropriate, but the questionnaire itself may fail to correctly implement the method. The researcher may simply ask the wrong questions.

3. Questionnaire Design Problems. Even if the correct questions are asked from the perspective of the researcher, they may not correspond with how the respondent views the issue, or some survey information may mislead the respondent. The researcher may be asking the right kind of questions, but in the wrong way. For example, the respondent could reject the property rights implied in the questionnaire, be influenced by the design of the questions, value a slightly different good or service due to a different understanding of the problem, or the respondent may be overtaxed by the difficulty of the questions. The result is the respondent may give valid responses, but for a different set of circumstances than the researcher believes he is addressing, or the results may be biased by the instrument.
4. Response Problems. Even if the questions are designed properly, correspond to the respondent's view of the issue and are well understood, the respondent may have difficulty accurately quantifying the responses required. This may be due to a lack of familiarity with the scenario of the good being valued, questions that are too difficult or inconsistent with the cognitive processes used in decision-making or due to a lack of effort in responding to the questions.
5. Implementation and Statistical Problems. Even with valid and accurate responses for individual respondents, incorrect sampling and small sample sizes may still lead to invalid results. Miscoding and statistical misinterpretation of data can add further error or bias.

Most research addressing the validity and accuracy of CVM applications has focused upon categories 2-4, although significant errors can result from all categories. Cummings et al. (1986) have identified several conditions they suggest must be met to have a high level of accuracy in CVM responses which include:

1. Subjects must understand and be familiar with the commodity to be valued.
2. Subjects must have had (or be allowed to obtain) prior valuation and choice experience with respect to consumption levels of the commodity.
3. There must be little uncertainty.
4. WTP, not WTA, measures should be elicited.

Cummings et al. suggest that when these conditions are not met, the CVM responses may still be valid, but the accuracy decreases. These conditions are useful to consider in evaluating a CVM, but they are not comprehensive (they fail to consider many other potential sources of inaccuracy), nor are they uniformly applicable to all CVM applications.

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Mitchell and Carson (1989) have provided a useful and structured presentation of many of the potential sources of inaccuracy and bias in the application of a CVM valuation exercise. These are found in Table 2.2-1. Other problems not identified above may also contribute to inaccuracy in CVM.

To address the accuracy and reliability of CVM results, Cummings et al. review 15 comparisons of CVM results with results using other valuation techniques, such as hedonic pricing models and travel cost models. In all of the comparisons, the calculated value estimates were within 60 percent of one another and many are much closer. This does not prove the accuracy of any one CVM is within 60 percent of the “true” value, but suggests that each of these methods may often converge to the same range of values and that the CVM method may be more desired in some instances due to its relative strengths as to when and how it can be applied. Mitchell and Carson (1989) provide similar evidence for a selected set of CVM studies.

### Conclusions on the Accuracy and Reliability of CVM

Reviewing the list of potential sources of error in CVM studies, one might conclude the results may often be invalid and inaccurate. However, careful design, pretesting, implementation, and interpretation of results can minimize biases and inaccuracies and yield valid and accurate value information. Next, the hypothetical nature of the questions need not result in invalid or inaccurate answers. Respondents often face WTP decision in markets, through political decisions and elsewhere that require real behavior similar to the hypothetical behavior in a CVM. According to Mitchell and Carson, “But can CV surveys actually measure values that are sufficiently reliable and valid for use in benefit estimation? Our conclusion is basically affirmative.” (1989, p. 295).

CVM is now widely used and is among the methods recommended by the United States Department of Interior for evaluation of natural resource injuries. Use of the method for these purposes was challenged recently in the United States Court of Appeals (Ohio vs. U.S. DOI, No. 86-1529). The court ruling denied the challenge stating, “We find DOI’s promulgation of CV methodology reasonable and consistent with Congressional intent, and therefore worthy of deference” (p. 94), and “We find no cause to overturn DOI’s considered judgment that CV methodology, when properly applied, can be structured so as to eliminate undue upward biases” (p. 96).

### **2.2.3 Specific Application Issues for Measuring Visibility Preservation Values**

While most all general CVM design and application issues are of concern in the valuation of visibility preservation values for national parks, a few issues are of specific concern, and are discussed below.

**Table 2.2-1**  
**Typology of Potential Response Effect Biases in CV Studies\***

- 
1. *Incentives to Misrepresent Responses*  
 Biases in this class occur when a respondent misrepresents his or her true willingness to pay (WTP).
    - A. *Strategic Bias*: where a respondent gives a WTP amount that differs from his or her true WTP amount (condition on the perceived information) in an attempt to influence the provision of the good and/or the respondents's level of payment for the good.
    - B. *Compliance Bias*
      1. *Sponsor Bias*: where a respondent gives a WTP amount that differs from his or her true WTP amount in an attempt to comply with the presumed expectations of the sponsor (or assumed sponsor).
      2. *Interviewer Bias*: where a respondent gives a WTP amount that differs from his or her true WTP amount in an attempt to either please or gain status in the eyes of a particular interviewer,
  
  2. *Implied Value Cues*  
 These biases occur when elements of the contingent market are treated by respondents as providing information about the "correct" value for the good.
    - A. *Starting Point Bias*: where the elicitation method or payment vehicle directly or indirectly introduced a potential WTP amount that influences the WTP amount given by a respondent. This bias may be accentuated by a tendency to yea-saying.
    - B. *Range Bias*: where the elicitation method presents a range of potential WTP amounts that influences a respondent's WTP amount.
    - C. *Relational Bias*: where the description of the good presents information about its relationship to other public or private commodities [hat influences a respondent's WTP amount.
    - D. *Importance Bias*: where the act of being interviewed or some feature of the instrument suggests to the respondent that one or more levels of the amenity has value.
    - E. *Position Bias*: where the position or order in which valuation questions for different levels of a good (or different goods) suggest to respondents how those levels should be valued.
  
  3. *Scenario Misspecification*  
 Biases in this category occur when a respondent does not respond to the correct contingent scenario. Except in A, in the outline that follows it is presumed that the intended scenario is correct and that the errors occur because the respondent does not understand the scenario as the researcher intends it to be understood.
    - A. *Theoretical Misspecification Bias*: where the scenario specified by the researcher is incorrect in terms of economic theory or the major policy elements.
    - B. *Amenity Misspecification Bias*: where the perceived good being valued differs from the intended good.
      1. *Symbolic*: where a respondent values a symbolic entity instead of the researcher's intended good.
      2. *Part-Whole*: where a respondent values a larger or a smaller entity than the researcher's intended good.
-

**Table 2.2-1**  
**Typology of Potential Response Effect Biases in CV Studies\* (cont.)**

- 
- |    |   |
|----|---|
| a. | <i>Geographical Part-Whole:</i> where a respondent values a good whose spatial attributes are larger or smaller than the spatial attributes of the researcher's intended good.  |
| b. | <i>Benefit Part-Whole:</i> where a respondent includes a broader or a narrower range of benefits in valuing a good than intended by the researcher.   |
| c. | <i>Policy-package Part-Whole:</i> where a respondent values a broader or a narrower policy package than the one intended by the researcher.   |
| 3. | <i>Metric:</i> where a respondent values the amenity on a different (and usually less precise) metric or scale than the one intended by the researcher.   |
| 4. | <i>Probability of Provision:</i> where a respondent values a good whose probability of provision differs from that intended by the researcher.  |
| C. | <i>Context Misspecification Bias:</i> where the perceived context of the market differs from the intended context.  |
| 1. | <i>Payment Vehicle:</i> where the payment vehicle is either misperceived or is itself valued in a way not intended by the researcher.   |
| 2. | <i>Property Right:</i> where the property right perceived for the good differs from that intended by the researcher.  |
| 3. | <i>Method of Provision:</i> where the intended method of provision is either misperceived or is itself valued in a way not intended by the researcher.  |
| 4. | <i>Budget Constraint:</i> where the perceived budget constraint differs from the budget constraint the researcher intended to invoke.   |
| 5. | <i>Elicitation Question:</i> where the perceived elicitation question fails to convey a request for a firm commitment to pay the highest amount the respondent will realistically pay before preferring to do without the amenity. (In the discrete-choice framework, the commitment is to pay the specified amount.) |
| 6. | <i>Instrument Context:</i> where the intended context or reference frame conveyed by the preliminary nonscenario material differs from that perceived by the respondent.  |
| 7. | <i>Question Order:</i> where a sequence of questions, which should not have an effect, does have an effect on a respondent's WTP amount.  |

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\* From Mitchell and Carson (1989). [Permission may be needed for inclusion in final draft]

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### Familiarity With the Resource Change

Estimating non-use values may pose some additional difficulties for CVM. The primary concern that has been raised is that the lack of familiarity with the good, or with thinking about dollar values for the good, may make respondents particularly susceptible to unintended influences in the survey instrument. Lack of familiarity is a concern with non-use values because the respondents will necessarily include individuals who have not used, and may never use, the resource. This may be particularly important when considering subtle ecological changes or obscure endangered species. However, in the present case, most people know what national parks are and have experience with various levels of visual air quality in their daily lives, even if they have never experienced varying visibility levels at a specific park. Therefore, they may be better able to comprehend and value visibility changes at national parks than for some other types of resource changes. The design of the questionnaire will allow this issue to be further addressed.

### Context and Information

Recent work by Fischhoff and Furby (1988) has extended the discussion of the context of simulated market transactions for visibility valuation. They assert, "In general, the more novel a transaction, the more of its details will need to be explained and the more difficult it will be to ensure that those details are understood." (page 152) They suggest that paying for visibility improvements may be a reasonably novel transaction and that seemingly irrelevant factors may affect responses. One might then infer that paying for preservation of visibility at national parks, especially by those who are non-users, may be even more novel. In part, these views are consistent with Shuman and Presser (1981), who have argued that the more crystallized the values and attitudes are, the less important minor context impacts are likely to be in survey design.

Fischhoff and Furby continue by identifying an array of potential characteristics of a visibility valuation transaction that may be of concern. These characteristics are broken down as defining main features of (1) the good, (2) the payment and (3) the social context of the transaction. For each of these three features, characteristics can be considered as helping to convey to the respondent "substantive" and "formal" definitions of the transaction. Substantive definitions refer to characteristics that help identify how the transaction affects the respondents directly, such as how their activities would be affected and how they would pay for the transaction. Formal definitions refer to technical specifications of the characteristics, such as duration and certainty of impacts. Many of these issues overlap the scenario development concerns identified by other CVM researchers, and summarized by Mitchell and Carson (1989).

Fischhoff and Furby suggest that to obtain accurate values for unfamiliar transactions, as visibility valuation may be, the transaction may need to be extensively defined. When characteristics of the transaction are left unspecified, respondents must rely upon their default assumptions, which may differ from one another and from what the researcher intended. They note, however:

.. simply telling people everything provides no guarantee that they have understood everything. Such a strategy might even impede understanding if attention to critical features of the contingent market is diverted by a deluge of details about features that could have gone without saying because they have little practical effect on decisions. (page 152)

The researcher must, therefore, balance the need for information against the interests of the respondents to absorb information. Relatively minor context features will have to be unstated for a CVM instrument to be manageable. The challenge for the researcher is to determine which information is critical in terms of the impact upon WTP measures of interest. In the current research, reported in Chapters 3 through 5 below, the baseline instruments are designed to incorporate many of the characteristics identified by Fischhoff and Furby. The guiding principle used in designing the context for the value elicitation is to keep it realistic and credible, but as simple and straightforward as possible. Several survey variations then alter the context and information presented to begin to specifically address some of the issues raised by these authors.

#### Part-Whole, Sequencing and Aggregation/Disaggregation

Part-whole bias, sequencing and the appropriate level of aggregation in the valuation, are three interrelated issues of particular concern to the valuation of visibility protection at national parks. Each is discussed and practical solutions identified below.

Part-Whole Bias. Mitchell and Carson (1989) define part-whole bias as occurring when a respondent values a larger or smaller entity than the researcher intended. Potential part-whole bias has been a significant concern in reviews of past urban visibility value studies where, for example, Fischhoff and Furby (1988) indicate:

... respondents might be told to disregard how a change in air pollution affected their health risk. However, such selective forgetting may not always be possible. If it is natural to think of an intervention's impacts as a whole, there may be no way to segregate mentally its individual effects. (page 155)

Concerns for the separation of health from visibility impacts of urban air pollution control are the focus of two ongoing CVM studies (Carson et al. 1989 and Irwin 1989), and preliminary results confirm, to some degree, the difficulty respondents have in separating these two characteristics of air pollution control in urban environments.

In the valuation of visibility protection for national parks, part-whole bias could enter in at least three ways:

1. Respondents fail to isolate visibility effects from other effects of air pollution, such as damage to vegetation and risks to human health.

2. Respondents fail to isolate visibility effects from other concerns about national parks, such as preservation of natural geologic features and prevention of water pollution. “Symbolic bias,” as suggested by Mitchell and Carson, is also potentially related in that a respondent may more broadly value protection at national parks rather than be concerned with the specific resource impairment of concern to the researcher.
3. Respondents fail to isolate visibility effects at the identified park(s) from similar effects at other park(s) or in other geographic areas.

Therefore, it is of significant importance to minimize the potential of these types of part-whole bias in the survey design, and to test and correct for any remaining part-whole bias in the CVM responses.

Sequencing. Sequencing bias occurs when the respondent provides different bids for the same resource protection depending upon the number and order of environmental protection issues to be valued. For example, Tolley et al. (1986) found the average stated WTP value for the visibility protection at the Grand Canyon was lower when respondents were first asked to give WTP values for visibility protection at other areas and then asked an incremental WTP for the Grand Canyon, versus when they were asked a WTP for visibility protection at only the Grand Canyon. These results are discussed further in Section 2.3.

In part, this sequencing effect may be due to individuals having a “mental account” for a category of environmental protection items based upon a limited ability to adjust their budget at any one time. As a result, as more and more resource protection items are to be simultaneously funded, the available financial resources per item decrease, and the average amount that can be paid for each item decreases. If this is only revealed to the respondent in an incremental manner (i.e., respondents are not told they will also have to purchase additional visibility protection at other areas, as was done by Tolley et al. 1986), the stated WTP for the later items considered may diminish as compared to if these items were first in the list, if the items are grouped under the same mental account.

These budget constraint and sequencing issues are not a unique problem for resource economics. A household’s WTP for a bundle of consumer goods may change if it is also, or first, required to buy a second bundle of goods and services. This may logically be the case because components of the two different bundles may be perceived as substitutes for meeting some of the goals (or motives) for which the bundles would be purchased; and because diminishing marginal utility for bundles of goods and services, and budget constraints, reduce the WTP for like incremental goods and services.

Several approaches may be taken to address sequencing effects. The simplest is to alter the sequence for which items are valued and retest the results, but this simply recreates the problem. The second, which is tied to the aggregation issue discussed next, is to define the entire policy package to be valued before the valuation commences.

Aggregation/Disaggregation. Aggregation refers to the appropriate level of resource impacts to consider; i.e., what is the total policy package of interest? Disaggregation refers to how value estimates should be obtained for individual components of the policy package.<sup>2</sup>

As discussed for sequencing, as more and more items are added to a policy package to be obtained at any one time, the WTP for any individual item may fall. In a similar vein, Irwin et al. (1989) and Boyce et al. (1990) found that while WTP estimates given for individual components of a good, such as visibility effects and health effects of air pollution control, are less than the WTP amount for the good as a whole, the sum of the values for individual components, when estimated separately, exceeded the WTP bid for the entire good. This may be reflecting part-whole bias, budget constraints and/or other economic and psychological response behavior. Therefore, it might occur that the sum of WTP values obtained from separate CVM studies for individual parks in a region (or regions in the country) may equal or exceed the WTP for simultaneous visibility protection throughout the region (or throughout the country).

Similar problems are observed when WTP questions are asked in terms of monthly payments versus annual payments: the monthly WTP estimates are less than the annual WTP estimates, but they sum to more than the single annual estimate. This may be reflecting failure to accurately consider budget constraints, or to fully comprehend the long term nature of the payment stream when providing monthly payments.

The solution to these problems is not entirely clear. Available research does suggest that the conservative direction to take in CVM exercises is to define and value the entire policy package of interest, then disaggregate to component values through follow-up questions or through statistical procedures. These component values may be for different parks, for different value motives or for other components of interest.

This solution does not mean that, for example, all potential natural resource protection issues must be simultaneously considered and valued in order to obtain a value for any one resource protection issue. For practicality, the researcher must take a common-sense approach concerning what the typical respondent will be able to isolate and what must be treated as a total package. Finally, natural resource policy often occurs sequentially and using values from independent studies covering independent issues in relative isolation may be appropriate as, through time, economic agents have time to readjust their budgets and may have the flexibility to fund additional (subsequent) resource protection.

### The Motives Behind the Value Statements

Understanding motives behind preservation values is important to the valuation exercise. This understanding allows more appropriate interpretation of what these motives are and why they exist, which may be used to refine the CVM design to measure values for motives

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<sup>2</sup> Irwin et al. (1989) discuss aspects of this issue using the term "additivity," rather than aggregation.

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as individuals see them, rather just as economists define them. This may also help in better understanding what types of resource quality and quantity changes will be of most value to society. Examining motives is also important as a means to evaluate the credibility of CVM responses, and to determine the appropriate application of the results for policy analysis.

Madariaga and McConnell (1987) have raised the question of motives behind bequest values from another perspective and suggest that certain kinds of motives can confound CVM responses and their interpretation for use in policy analysis. They argue that there are two types of altruism that could underlie bequest motives. The first is an "individualistic altruism" that is based on the utility of others and assumes the bequestor would not want to leave a bequest that costs the receivers more than it benefits them. The second type is defined as "paternalistic altruism" that is based on another's consumption of a specific good because it will be good for them.

Based upon the above definitions, Madariaga and McConnell develop a model that suggests that the usual efficiency criteria (that the sum of individual benefits exceeds costs, where those benefits do not include any interdependence of utility) still gives the optimal allocation of resources even in the presence of utility interdependence. This applies to the "individualistic altruism" bequest motive -- benefits to future users must exceed costs to future users or the altruist gains no utility. They conclude that knowing who bears future benefits and costs, and how much they are, is desirable information to be included in contingent valuation questions. What is not stated, however, is how to present future costs and benefits when they are uncertain. They apply this conclusion with some small sample empirical tests and find that willingness to pay is indeed smaller when subjects are told that future users will incur costs as well as benefits.

We suspect that the paternalistic altruism, which is given limited attention by Madariaga and McConnell, may be important with regard to parks. To the extent that a person believes that others should have the perspective and ethical value associated with contact with the natural environment, he may derive satisfaction from knowing the parks are available for those he cares about regardless of, and almost certainly not knowing, whether they would have been better off (in terms of maximum attainable utility) under a different allocation of resources. Many of the choices that have been made to establish and protect national parks were made without knowledge of future expenses, and may well reflect a societal "paternalistic altruism."

An additional aspect of this paternalistic altruism may be the perception that there is a broad social externality from the availability of the resource that goes beyond the well-being of any one individual who actually uses the resource. In this case, it is not that the bequestor's utility is directly enhanced because of use of the resource by specific individuals, but rather because society as a whole may be better off in a way that exceeds the sum of each individual's direct benefits. For example, consider programs taking juvenile delinquents on wilderness experiences, which are intended to help with self confidence and perspective, and hopefully reduce future crime.

Another potential motive behind bequest value responses may be the perceived irreversibility of failure to protect many natural resources. Even though in this case visibility degradation is a reversible impact (the air clears up when emissions are reduced), there may be a perceived irreversibility in terms of policy precedence. It may be that some people perceive that if we allow the degradation now, we give up the right to prevent it in the future, and open the door to other environmental degradation.

To a considerable extent, these discussions of motives behind bequest values are speculation without empirical research to determine which motives dominate. A detailed analysis of bequest values motives is beyond this study's focus and resources. This study does attempt to obtain attitudinal information to understand and verify bequest values, and attempts to circumvent the problem of interdependence of utility in the survey design.

## **2.3 PREVIOUS CVM STUDIES CONCERNING PRESERVATION VALUES**

The section provides a brief review of selected CVM studies that have been conducted concerning visibility protection at national parks and concerning other similar natural resource protection issues.

### **2.3.1 Preservation Value Studies for Visibility Protection at National Parks**

One previous CVM study, called the Southwest Parklands study, has estimated preservation values for changes in visibility at the Grand Canyon National Park and at all national parks in the Southwestern United States (Schulze et al. 1981). The Southwest Parklands study is the only previous CVM study that is directly comparable to the study being presented in this report. Two small follow-up studies of the Southwest Parklands study have been conducted to examine specific questions raised about the Southwest Parklands study (Tolley et al. 1986; and Rahmatian 1986). Rae (1984) also examined a few questions concerning preservation values for visibility protection at Great Smoky Mountains National Park.

#### **Southwest Parklands Study**

The Southwest Parklands study represents the first attempt to estimate preservation values for visibility protection at national parks with respondents not physically on-site at the parks in question. The results reflect estimates of preservation values for non-users as well as for users. Respondents were interviewed in-person in four major metropolitan areas: Los Angeles, Albuquerque, Denver, and Chicago. Four hundred and fifty completed (non-protest) responses were obtained for the preservation value questionnaire. Three basic questions were addressed: What is the value of controlling haze at the Grand Canyon National Park? What is the value of controlling haze throughout the remainder of the Southwest region? and, What is the value of controlling plumes visible from the Grand Canyon National Park?

In the introduction to the preservation value questionnaire, respondents were told that air pollution from human sources sometimes impairs visibility at the Grand Canyon, and were shown a set of photographs of the Grand Canyon. The photos showed three different scenes, each under five different visibility conditions (fifteen photographs in total). The respondents were told that the five photographs in each set showed conditions ranging from good visibility to poor visibility, with the middle photographs reflecting current average visibility conditions. Respondents were not given any quantitative information such as frequency percentiles or visual range for the conditions shown in the photographs.

The first set of questions concerned previous and expected future visitation to the Grand Canyon and other national parks in the Southwest. Respondents were then told that additional industrial emissions controls might be required to prevent visibility at the Grand Canyon from deteriorating and that such controls would likely make electricity more expensive. They were asked to estimate what they would be willing to pay in increases in their monthly utility bills to prevent an increase in air pollution that would cause average conditions to deteriorate from the middle photos to the next worse photos. This represented a change from approximately the current (1979) 50th percentile of visibility conditions to approximately the then current 25th percentile. The photographs represented approximate visual range levels of 200 km and 155 km. The respondents were then shown a similar set of photographs showing scenes from three national parks in the Southwest (Grand Canyon, Mesa Verde, and Zion) and were asked what additional amount they would be willing to pay to prevent the same deterioration in visibility throughout the region.

Respondents who gave zero WTP were asked if they thought the change in visibility was not important, or if they thought someone else should pay. The second response was interpreted as a protest response and these zeros were dropped from the results. The authors do not report the total number of zero responses obtained or the number interpreted as protest zeros for the preservation value responses.

The average monthly WTP responses per household were (after exclusion of protest responses):

Mean for Grand Canyon NP	\$5.50
SE of Mean	0.41
N	450
Mean for remainder of region	\$4.66
SE of Mean	0.36
N	450

Adjusting to 1988 dollars and multiplying by twelve to obtain an estimate of annual WTP, these results imply an average annual 1988 WTP per household of \$95 to prevent a degradation in visibility from the 50th to the 25th percentile at the Grand Canyon due to haze, and an additional \$80 for preventing this amount of degradation at all other parks in the region.

The analysis of the WTP responses reported by the authors suggests no relationship between the WTP amount stated and the distance of residence from the Grand Canyon, and very little relationship between the WTP amount stated and previous or expected future Grand Canyon visitation. Older respondents gave significantly lower WTPs and respondents with higher incomes were associated with higher WTPs. The income elasticity was approximately 0.3, implying that a 10 percent higher income was associated with a 3 percent higher WTP response.

Questions have been raised about the effect in this study of focusing on such a perceived “national treasure” as the Grand Canyon and whether the responses would be the same if other areas were also considered at the same time. The concern is that respondents may have overstated their true WTP for the Grand Canyon and included some value for changes in visibility in other areas as well. A related question raised is whether stated WTP for visibility protection at the Grand Canyon would change if respondents were also requested to simultaneously spend more to protect visibility in other areas.

#### Southwest Parklands Follow-up Studies

Two follow-up studies have attempted to address some of the questions concerning the Southwest Parkland Study. While the followup studies do not entirely resolve issues in the original study, they do suggest that some problems may exist.

Tolley et al. (1986) addressed the question of whether responses would be different if respondents were asked to give WTP for changes in visibility where they live as well as for protection of visibility at the Grand Canyon. A sample of residents in Chicago was asked a set of three WTP questions: (1) WTP to prevent a degradation in visibility in Chicago, (2) additional WTP to prevent a similar degradation throughout the remainder of the U.S. east of the Mississippi, and (3) additional WTP to simultaneously protect against a specified degradation in visibility at the Grand Canyon. The Grand Canyon photographs and hypothesized change were the same as those used in the Southwest Parklands study. All the questions were for monthly increases in utility bills to cover costs of pollution controls. The results are summarized in Table 2.3-1 (adjusted to annual WTP in 1988 dollars).

Even though the sample sizes are small, the WTP estimates for the Grand Canyon are substantially smaller when asked as the third in a series of WTP questions. The authors conclude that the WTP responses are influenced by the order of the questions. In the Southwest Parklands study, the change in visibility being considered was for the Grand Canyon only, while in the follow-up study the visibility change is for Chicago, the East and the Grand Canyon all at once. This appears to be a change in the good being valued as well as the order of the questions. The results therefore are best interpreted as demonstrating that when considering a change in one area such as the Grand Canyon, it is important to consider whether changes in visibility would also occur in other areas as part of the same policy package. It is a substantially different question for the respondent to give WTP for changes in, for example, the entire U.S. versus WTP for changes in just

**Table 2.3-1**  
**Comparison of Schulze et al. and Tolley et al.**  
**Grand Canyon Visibility Value Results**

	Annual WTP for Chicago	Annual Additional WTP for Remainder of East	Annual Additional WTP for Grand Canyon
Tolley et al. (N = 59)	\$296	\$36	\$21 (SE = 12)
Schulze et al. (Chicago sample, N = 130)			\$132 (SE = 20)

one location, such as the Grand Canyon. With income constraints, and assuming visibility is a normal good, one would expect that incremental WTP to prevent degradation at an additional site would be smaller than WTP for the same site if it were the only site needing protection. This is the aggregation issue discussed above.

This problem may have been further exacerbated by the procedure used in the Tolley et al. study. Respondents were not informed at the beginning of the WTP questions that they would be asked to give estimates of WTP for visibility protection in more than one location, which reinforces sequencing problems, as discussed above. As a result, respondents may have allocated a larger share of this "visibility budget" to the first site considered as if it were the only item in a policy package, than they would have if they had considered all three sites simultaneously as part of one policy package.

A second follow-up study was conducted in Denver in 1982 (Rahmatian 1986), also with the aim of examining the effect of considering changes in visibility at the Grand Canyon alone versus changes in a larger area as well as the Grand Canyon. Some subjects were asked to give willingness to pay estimates for the Grand Canyon alone. Others were shown photographs of the Grand Canyon and other parks in the Southwest and then asked to give willingness to pay estimates (1) for the Grand Canyon and then (2) for the parks in the remainder of the southwest region. This second protocol is similar to the questions asked in the Southwest Parklands study except that the photos for the region as well as for the Grand Canyon were shown before the willingness to pay questions were asked. There is no statistically significant difference in the mean WTP estimates given for the Grand Canyon in these two procedures, and in both cases the mean responses are not statistically significantly different than the results obtained in the Southwest Parklands study. However, the Grand Canyon question was asked first in both cases; therefore, the results do not adequately address the question of whether responses are different if the order of the questions is changed.

Other concerns with the Southwest Parklands study include the separability of visibility from other resource protection issues. For example, a major concern regarding measuring visibility values is whether other effects of air pollution, such as health effects or vegetation damage, are being separated fully from visibility protection values. There is also concern that park resource protection motives unrelated to visibility may be reflected in the responses. This is the potential part-whole bias discussed above.

The focus of the Southwest Parklands study was also geographically limited and only one level of change in visibility conditions related to haze was valued. The uncertainties involved with transferring these results to other locations and other visibility change scenarios limits the applicability of the results for current policy issues without further verification with new research. Finally, some questions have been raised about specific design elements of the CVM application in this study, such as the order of the questions and the use of the monthly utility bill payment vehicle.

#### Rae (1984)

Rae (1984) conducted a CVM study in Cincinnati, Ohio, which primarily focused on benefits of reducing urban air pollution, but a few questions were also asked later in the questionnaire about visibility at the Great Smoky Mountains National Park. Interviews were conducted with 316 adults. Visibility at Great Smoky Mountains was illustrated with two photographs of a scene at the park showing 20 km visual range and 100 km visual range. Subjects were asked the maximum their household would be willing to pay annually to have visibility conditions at the park like those shown in the 100 km photograph most of the time rather than the 20 km conditions. No payment vehicle was specified. A list of values (in intervals) ranging from \$0 to \$500 was shown to the subjects. Subjects were asked about past and expected future visits to the park. After excluding one \$1000 response, the average response to the first visibility question regarding Great Smokies was about \$60. A significant portion of the subjects had visited the park and/or planned to visit it in the future, so this willingness to pay can be expected to reflect perceived benefits associated with actual visits as well as potential non-use values.

Subjects were also asked a second set of questions about their willingness to pay for ten "good causes," including protecting visual air quality at Great Smokies, to see how their responses might change when more than one good cause was considered. The average willingness to pay for visibility protection at the park was about one-third of the previous average response. This suggests the possibility that subjects may not be considering the full range of alternative uses of their money when they are asked to estimate their willingness to pay for a single good cause, and that when competing "good causes" are also included, the willingness to pay for one of the causes may be smaller. However, in this question the magnitude of the change in visual air quality and in the other good causes was not specified. This uncertainty may also play an important role in the change in visibility bids. Cummings et al. (1986), Mitchell and Carson (1989), and Fischhoff and Furby (1988) all suggest uncertainty leads to inaccurate, and often reduced, bids.

### **2.3.2 On-Site Use Value Studies for Visibility at National Parks**

A number of contingent valuation studies have been conducted that have estimated dollar values for visibility impacts to on-site visitation at national parks. More extensive reviews of these studies can be found in Chestnut and Rowe (1983). These studies are briefly discussed here because they are CVM studies concerning visibility protection at national parks, but their focus was much different than that of the current study.

Results of on-site use value studies concerning visibility at national parks are summarized in Table 2.3-2. Two of these studies have obtained estimates of use values for changes in visibility at the Grand Canyon, one of the parks selected for the focus of this study. In both of these studies survey respondents were asked what they would be willing to pay in additional daily entrance fees to have one level of visibility rather than another while visiting the Grand Canyon National Park.

MacFarland et al. (1983) interviewed about 1000 visitors at the Grand Canyon and at Mesa Verde in the summer of 1980 for the willingness-to-pay portion of their study. Visitors interviewed at the Grand Canyon were shown two sets of slides, each showing five different levels of visibility at a particular viewpoint. The authors report approximate levels of visual range for the five different conditions, as shown in Table 2.3-2. Respondents were asked to estimate the most they would be willing to pay in additional daily entrance fees, over the then current two dollars, to have visibility at level B, C, D, and E rather than level A while visiting the park. Possible response options were provided to respondents using a checklist format. The mean responses are shown in Table 2.3-2.

Schulze et al. (1981) interviewed 166 subjects for the use value portion of the Southwest Parklands study. Subjects were interviewed at their homes in Albuquerque, Denver, Los Angeles, and Chicago. Respondents were excluded from the use value questions if they said that they had not visited the Grand Canyon in the last 10 years and if they did not plan to visit the Grand Canyon in the next 10 years. The willingness to pay questions were very similar to those asked by MacFarland et al. The primary difference was that the respondents were interviewed at their homes rather than at the park and some of them (roughly 40%) had not been to the park in the last 10 years. Schulze et al. do not report visual range estimates for their photographs, but they report  $\mu\text{g}/\text{m}^3$  pollutant loadings and visibility frequency percentiles the photos represent based on point contrast measurements taken throughout the summer of 1979. We have calculated approximate visual ranges for these pollutant loadings and percentiles from historic data on visual range levels at the Grand Canyon (reported by NPS 1988 and by MacFarland et al. 1983). These estimated levels of visual range and the mean WTP responses obtained by Schulze et al. are shown in Table 2.3-2.

Other use value studies for changes in visibility at parks or recreation areas have typically asked visitors what they would be willing to pay in additional park entrance fees to ensure one level of visibility during their visit to the park versus another level. In general, the

**Table 2.3-2**  
**On-Site Use Values for**  
**Visibility Protection at Recreation Sites: Selected Studies**

Study	Site <sup>a</sup>	Observations	Initial Visibility (miles)	New Visibility (miles)	\$1988 WTP Per Visitor Party Day	Method Used <sup>b</sup>
Rowe, et al. (1980)	Navajo	26	75	50	\$6.98	IB
	Navajo	26	75	25	\$11.14	IB
	Navajo	26	50	25	\$5.19	IB
Schulze, et al. (1981)	GCNP	166	75	95	\$2.47	CL
	GCNP	166	75	125	\$4.06	CL
	GCNP	166	75	175	\$5.73	CL
	GCNP	166	75	240	\$7.57	CL
McFarland, et al. (1983)	GCNP	1000	70	100	\$1.40	CL
	GCNP	1000	70	130	\$2.34	CL
	GCNP	1000	70	165	\$3.07	CL
	GCNP	1000	70	215	\$4.03	CL
	MVNP	800	70	100	\$1.24	CL
	MVNP	800	70	130	\$1.68	CL
	MVNP	800	70	165	\$2.56	CL
	MVNP	800	70	215	\$3.73	CL
	MVNP	196	74-95 <sup>c</sup>	160	\$4.42	CR
	MVNP	193	95	160	\$11.88	CL
Rae (1983)	GSMNP	202	6-12 <sup>c</sup>	60	\$5.67	CR
	GSMNP	202	12	60	\$3.76	CR
	GSMNP	201	12	60	\$2.94	CL

a GCNP = Grand Canyon National Park, MVNP = Mesa Verde National Park, GSMNP = Great Smoky Mountains Park, Navajo = Navajo Reservoir, NM.

b All studies used entrance fee vehicles  
 IB = iterative bidding  
 CL = Check list of value ranges to select from  
 CR = Contingent ranking

c Two scenarios, each with a different baseline, provided indistinguishable results and were merged together.

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mean WTP estimates obtained in these studies range from \$2 to \$8 per day per household. These studies are summarized by Chestnut and Rowe (1983), Freeburn (1987) and Gilbert (1989). The results obtained for national parks other than the Grand Canyon are not dramatically different, suggesting that there is not a noticeable premium for the Grand Canyon at least when it comes to on-site use values.

One thing that is striking about the on-site use value results is how small they are compared to expenditures, stated response behavior to visibility changes, and other consumer's surplus estimates, given that viewing is often cited as the single most important activity at national parks. No one has estimated the total consumer's surplus associated with a visit to the GCNP, but Haspel and Johnson (1982) and Johnson and Haspel (1983) estimated total WTP for a visit to Bryce Canyon National Park (BCNP), with average visits lengths of 1 day, at between \$93 and \$130 (\$1988). We have no reason to expect the consumer's surplus for visits to the GCNP would be substantially less than for BCNP. Finally, the results found by MacFarland et al. (1983) suggest that 50 percent changes in visual range at the GCNP would result in a majority of visitors changing their time spent at the park by 13 to .5 hours, a figure that seems potentially inconsistent with WTP estimates of a few dollars per day per visitor party.

There are several possible reasons why the available estimates of the on-site use value component of visibility related consumer's surplus estimates for the GCNP are relatively small.

1. The values may be accurate. Values may be small because while viewing is important, it is not the only aspect of the experience. Moreover, recreators have the ability to substitute to other sites, or in some cases to other activities. Finally, it may be the case that with high trip costs, there is little consumer's surplus left.
2. The reported values may be biased due to survey design elements. Most of these surveys represent relatively early CVM exercises. The responses to these early WTP questions may be biased downward as a result of psychological response behavior that has been identified in the literature, but cannot be statistically adjusted for with the current data. Psychological research suggests that "anchoring and adjustment" problems frequently occur in choice making (Slovic 1969). Individuals may anchor on a well understood situation or value, such as current entrance fees, and adjust this value to respond to the CVM scenario. This adjustment process often falls short of being complete. Respondents may be further anchoring upon what is felt to be a "reasonable" payment, rather than the maximum payment they would make before they would choose the alternative.

Of importance for the studies summarized in Table 2.3-2 is that they used entrance fee vehicles that may have anchored respondents upon the then typical \$2 entrance fee. Respondents may have been psychologically prone to consider that if they pay \$2 for an entrance fee (covering the whole experience), then something on this order may be "reasonable" to protect the viewing component of the experience. Moreover, respondents

may have objected to the suggestion that national park entrance fees be used to generate funds to control nearby industrial emissions. Little was done or reported in past studies to test or adjust for these types of problems.

Some recent research may support the above argument for downward bias in the on-site use values. Gilbert (1989) estimated changes in consumer's surplus for haze impacts to recreation in Vermont. This study first had respondents allocate trip costs to viewing scenery (called scenery costs), and to other purposes, then asked for an incremental WTP to obtain improved visibility, or to prevent visibility degradation. In contrast to earlier studies, the scenery cost variable serves as the anchor rather than entrance fees and estimated values per day are much higher. Another study by Rowe et al. (1989) examined CVM and travel cost consumer's surplus measures for Atlantic salmon fishing in Maine. The CVM estimates, using a fishing license vehicle, roughly equaled the current license fee, while the travel cost estimates were nearly 10 times larger. The most apparent explanation for this difference was the potential influence of the current license fee as an anchor as to "reasonable payments," which was reinforced by written comments from respondents.

### **2.3.3 Other Similar CVM Preservation Value Studies**

Several other studies address similar preservation valuation issues and have study designs and findings that are instructive for the present study. Two studies (Bishop and Boyle 1985, and Walsh et al. 1982) have estimated total preservation values for protecting sites similar to parklands. The purpose in these studies was different than for the present study because the value being elicited was for preservation of the site (or sites) as a nature preserve or wilderness, rather than for changes in the quality of the resources at these sites. Another study of interest (Sutherland and Walsh 1985) examined the relationship between preservation values for protection of water quality at a recreation site and the distance of the subject's residence from the site.

A fourth study reviewed here (Carson and Mitchell 1988) has estimated total values for protection of the quality of freshwater lakes, rivers and streams (exclusive of drinking water) throughout the country. Although the subject matter is different, there are some similarities to this study in that the subject is the quality of an environmental resource that occurs in all parts of the country and varies from place to place. It is also similar in that the general population was sampled whether or not they were involved in any water related recreation activities.

#### **Bishop and Boyle (1985)**

Bishop and Boyle used a mail questionnaire to obtain values to Illinois residents for preserving the Illinois Beach State Nature Preserve, which is located at the southern end of the Illinois Beach State Park on Lake Michigan. The Nature Preserve is currently

threatened by erosion of the sand dunes which if allowed to continue will result in the flooding of the Nature Preserve. A stratified random sample of 600 Illinois residents was selected and the overall response rates were 63%.

Information about the Nature Preserve was included in the form of maps and questions and answers. The willingness to pay question was the close-ended referendum style. Respondents were asked whether they would pay a given amount for a membership to a private foundation that would provide the funds necessary to build an off-shore breakwater and manage the Nature Preserve day to day. Follow-up questions were asked to find out what respondents thought about their answers to the membership question. Additional sections of the questionnaire probed respondents about their familiarity with the Nature Preserve and about their attitudes toward environmental protection and this questionnaire.

Respondents' familiarity with the Nature Preserve was not high even for respondents from nearby counties, but 77% of the sample said that it was somewhat or very important to them personally that the Nature Preserve be preserved. This percentage was about the same for the residents of nearby counties, and for those who live further away and were much less familiar with the Nature Preserve. This suggests that visitation to, or even name recognition of the specific site, may not be as important as might be expected.

The weighted average annual willingness to pay to preserve the Nature Preserve in its current state was \$28 per household. The authors took a conservative approach in calculating total values for the State by presuming that non-respondents placed no value on preservation of the Nature Preserve, because those who do not return the questionnaire are more likely to care less (but not necessarily zero) about the resource in question.

Responses to the follow-up questions and the environmental protection attitudes provide some insight about how the respondents were thinking about the issue in general and how they reacted to the presentation of the issue in this particular questionnaire. These types of follow-up and attitude questions are very helpful in interpreting the results of the valuation questions, especially with a mail questionnaire where there is no chance to gage the respondents reaction in any other way.

More than half of the respondents who said yes to the membership question, also checked the follow-up response that said "I don't know what I would pay for a membership, but I thought the State Nature Preserve should be preserved." About 85% of the respondents said that it was definitely or probably true that they thought their response was important because they could participate in the decision of whether to preserve the Nature Preserve. These responses suggest that a significant percentage of the respondents were uncertain about what they would have paid for a membership, but that they said yes to the amount asked because they wanted to "vote for" preservation. However, when presented with the statement, "I felt that preserving the State Nature Preserve would not really cost me anything because the membership question was hypothetical," about 62% of the respondents said this was probably or definitely false. It appears that the respondents were uncertain about the actual payment they were willing to make, but that they took the questionnaire seriously and believed that their responses would have an effect on the policy decisions that were made and ultimately on costs that they would bear.

Responses to questions about general environmental protection attitudes also give an idea how respondents think about these issues. The majority of respondents indicated their sentiments that the plants and animals have a right to exist and that human interests should not take precedence. The respondents seemed to be expressing a kind of environmental ethic that was discussed above in the context of existence value. This may be related to why such a large portion of the respondents said that it was somewhat or very important to them personally that the Nature Preserve be protected even though only a small percentage of them had ever visited it. The findings on response attitudes, accuracy and motives suggest these are important issues deserving more attention.

Walsh et al. (1982)

This study obtained estimates of willingness to pay to preserve wilderness areas in Colorado. A mail questionnaire was sent to 600 Colorado residents during summer 1980, with a response rate of 40%. Four maps of the State illustrated alternative levels of wilderness protection, ranging from the then-current area (1.2 million acres) to up to 10 million acres. Respondents were also asked their willingness to pay to preserve alternative amounts of wilderness throughout the remainder of the country.

Respondents were asked to assume that the only way to preserve wilderness in Colorado would be by paying into a special fund to be used exclusively for that purpose. They were then asked the maximum they would be willing to pay each year for each of the four levels of protection. Following this question they were asked to estimate what portion of their payment they would allocate for the following reasons, which the authors interpreted as use value, option value, existence value, and bequest value respectively:

- Payment to visit existing or potential Wilderness Areas this year.
- Payment for the option to visit existing or potential Wilderness Areas in the future, should you choose.
- The value to you from knowing there exists a natural habitat for plants, fish, wildlife, etc.
- The value to you from knowing that future generations will have Wilderness Areas.

Approximately 84% of the respondents were willing to pay some positive amount for the preservation of at least the amount of designated wilderness that existed in Colorado in 1980 and 77% were willing to pay some positive amount for wilderness preservation throughout the country in addition to the payment for Colorado wilderness. Average annual willingness to pay per household for 1980 level wilderness in Colorado was \$26, with approximately 45% of this amount being allocated to use value. Average annual additional willingness to pay per Colorado household to preserve current (1980) wilderness

throughout the remainder of the country was \$14, with about 20% being allocated to use value. Willingness to pay was higher than this for larger amounts of wilderness in Colorado and throughout the country, although the proportion allocated to use value was somewhat higher for the higher acreage amounts. The percentages of the payment allocated for option, existence, and bequest values were roughly similar, although the percentage given for option value tended to be somewhat smaller than for the other two.

Total values, including both use and preservation values, were significantly related to the distance from the respondent's residence to the nearest wilderness area and to the amount of wilderness visitation made. More frequent visitors and those living nearer gave higher values for both use and non-use motives.

Responses to questions concerning the importance of various reasons for preserving wilderness indicated that preservation related motives were considered somewhat more important than user motives. Protection of water quality, air quality, and wildlife habitat, and knowing that future generations will have wilderness, ranked slightly above recreation use values and option of future use values.

#### Sutherland and Walsh (1985)

Sutherland and Walsh conducted a CVM study concerning the protection of water quality from degradation due to coal mining in the Flathead River and Flathead Lake area in Montana. This is a recreation area currently used primarily by local residents. Seventy-five percent of the visitors are from Montana and most of the remaining visitors are from neighboring states. The authors were particularly interested in examining the relationship between the WTP responses and the distance the respondent lives from the site.

A mail survey instrument was sent in the summer of 1981 to a sample of residents from four Montana cities located various distances from the site. These distances were 10, 115, 227, and 420 miles. Usable responses from 171 residents were obtained. The response rate was 61 percent. Respondents were asked the total annual amount their household would be willing to pay into a special fund to protect water quality in the Flathead River and Lake area. They were then asked to allocate this payment across four reasons they may want to protect water quality in this area:

1. For their own visits to the area in the current year.
2. For their future visits to the area.
3. To know that good water quality exists in the area.
4. To know that future generations will have good water quality in the area.

The mean total preservation value response was \$64, with \$7, \$11, \$20, and \$26 being the average amounts (based on percentage of the total) for each of the above reasons, respectively. The results of the analysis of the WTP responses indicates a significant relationship between the WTP response and the distance of residence from the site, and between the WTP and the frequency of visitation to the site, which was also correlated with distance from the site. The authors report that the observed relationship suggests that the value falls to near zero at about 640 miles, although this is based on an extrapolation outside the range of residence distances included in the sample. The authors stress that unlike well-known national parks that might be considered national environmental resources due to wide dissemination of information about them, the Flathead River and Lake area is more of a regional resource with which most non-visitors are not very familiar.

Carson and Mitchell (1988)

Carson and Mitchell conducted a nationwide survey in 1984 concerning the value of protecting the quality of freshwater lakes, rivers and streams throughout the country. In-person interviews were conducted with 813 individual, with 79% of the eligible respondents completing interviews.

The potential range of water quality levels was described with the help of a ladder on which four water quality levels were shown: swimmable, fishable, boatable, and too polluted for any human, plant, or animal contact. It was explained that with current pollution control efforts, 99% of the nation's freshwater lakes, rivers, and streams are at least boatable with most being fishable and perhaps 70-80% being as clean as swimmable. Subjects were told that they are currently paying for pollution control efforts through higher prices and taxes, and that if these control efforts were stopped that the water quality in areas that can now be used only for boating would in many cases fall to less than boatable.

Subjects were asked to give the maximum they would be willing to pay for their household in taxes and higher prices (including the amount they are currently paying) to ensure that the boatable level is maintained in virtually all (99%) water bodies; the maximum additional amount they would pay to have a minimum level of fishable; and the maximum additional amount to have a minimum of swimmable. In follow-up questions subjects were shown estimates of typical amounts paid through higher prices and taxes for water quality protection by households in a similar income category, and were asked if they wanted to revise their responses. A subset of subjects were also told the typical amount a household in their income bracket is paying for air pollution control as well as water pollution control. The idea was to test for the possibility that people forget that water pollution control is only one aspect of environmental quality and would therefore revise their responses downward given the information about air pollution control expenditures. Subjects were also asked if they would still be willing to pay the amount they gave for the fishable level if 5% of the nation's water bodies remained at the boatable level, and if 50% remained at boatable. Subjects were also asked to divide their willingness to pay between the state where they live and the remainder of the country.

Usable willingness to pay responses were obtained from 70% of those who were interviewed. The breakdown of those who did not give usable responses was as follows: (1) 72 said they didn't know; (2) 133 gave protest zeros with explanations falling into one of two groups, attitudes of anti-governmental taxes and expenditures or strong environmentalist attitudes with feelings that putting dollars on such things is immoral; (3) 16 gave responses of more than 5% of their incomes and were judged to be too high; and (4) 10 gave very low estimates (e.g. \$1) that were judged to be protest responses that were not caught because a value other than zero was given.

The mean response per household to obtain the swimmable level for all freshwater lakes, rivers, and streams from the baseline of what would occur without current controls (i.e., non-boatable in some areas) was \$280 (1984 dollars) per year. The authors used a statistical procedure to account for potential non-response bias when they aggregated to a U.S. total. Responses were weighted to make the sample more representative of the Census population. This adjustment resulted in a 12 percent reduction in the mean WTP value for obtaining the swimmable level.

The authors use an indirect approach to separate values for different motives by comparing the values given by users versus non-users. When non-users were defined as those who reported no in-stream (or in-lake) recreation by household members in the past year, non-use values were at least 30% of total values. When non-users were defined as those who reported no direct or indirect use (e.g. picnicking by a lake or stream), non-use values were at least 19% of total value. These are lower bounds in that no non-use value is attributed to users, although expectations about potential future use by those who were non-users last year are unknown.

Responses indicated that subjects considered the 95% option to be essentially equivalent to the full attainment of the fishable level in all water bodies, and the reduction that was made in responses if only 50% would obtain the fishable level was significantly less than half the original amount given. There is the possibility that subjects were influenced by the wording of the question. Since it asked whether they would still pay the amount they originally gave, there may have been some reluctance to change their answers. A more neutral approach would have been to ask what they would pay for the alternatives involving less than complete attainment of the fishable level.

Subjects reported that about two-thirds of their willingness to pay was for water quality in their own state and one-third for the remainder of the country. The changes in the estimates after subjects were shown estimates of the amount they currently pay for water quality protection, were small. Those whose first response was below their current payment estimates tended to increase their responses somewhat, and those whose first response was above their current payment estimates tended to stay the same. Overall, the subjects' willingness to pay responses were surprisingly close to estimates of their current payment.

Responses concerning willingness to pay for water quality protection did not change significantly when estimates of current payment for air quality protection were also shown to the subjects. This is different than the findings in some previous surveys that found significant changes in responses when more issues were introduced. Since the way these tests were made differ, it is difficult to draw satisfactory conclusions from these findings. This finding may have been the result of introductory information concerning a variety of public issues that may have served to help respondents think about water quality protection issues without forgetting about other competing demands on their budgets. An alternative explanation is that respondents may become defensive when new information is presented that suggests they should reconsider their bids, and therefore refuse to revise their responses.

Finally, income was found to be significantly related to the responses, showing an income elasticity of about 1. This is a larger income effect than has been found in many willingness to pay surveys and may have been influenced by the income adjusted anchors used on the payment cards.

#### **2.3.4 Lessons from the Related Research**

Several key lessons from related research highlight issues and directions to be addressed in the current effort.

- The preservation value studies have addressed issues from local sites to nation-wide concerns. The WTP values also vary considerably, from tens of dollars to hundreds of dollars each year, and reflect that respondents do not simply give the same response for any preservation value WTP question. Overall, evaluations of these surveys indicate respondents generally take the survey seriously and attempt to give valid responses to the CVM questions. Respondents acknowledge uncertainty in the accuracy of their responses.
- The researcher must carefully present the policy package of interest, and perhaps present information on related policy actions.
- WTP response tend to generally reflect expressed attitudes and behavior conveyed in other parts of the survey. The use of this type of information is critical for evaluating the survey responses.
- Values in previous studies are found to be related to expected use and often to distance from a site, although this impact may be lessened for more prominent sites, such as national parks. Therefore, these data should be collected.

- Follow-up questions that ask respondents to comment on and evaluate their WTP bids were well received and may be of particular importance in evaluating a CVM application. Respondents acknowledge uncertainty in the accuracy of their responses to total preservation value questions, and addressing the level and impact of this uncertainty upon the analysis is of particular importance for preservation value studies. On the other hand, follow-up questions that ask for new bids based upon new information may not be well received.
- Larger changes in resource provision, beyond the initial proposed change, may result in relatively flat WTP response surfaces, although little investigation has been given to this issue.
- Separating, or disaggregating, values to individual value motives may be a difficult exercise for respondents, just as it is for other characteristics of air pollution control. (See Section 2.2.3). However, using indirect methods, such as in Carson and Mitchell 1988 may add even more error to the exercise. The estimates of value for individual components obtained in these studies are consistent with other survey evidence, although the average option price estimated in Walsh (1982) is quite large relative to theoretical expectations (Freeman 1988). It may be inappropriate and overtaxing to ask respondents to consider separately current use, option value and future use in favor of just asking for values related to current and potential future use.

### **3.0 STUDY DESIGN**

This chapter describes the design of the survey instrument and the implementation procedures.

#### **3.1 DEVELOPMENT OF THE SURVEY INSTRUMENT**

This study was designed to address some of the questions that have been raised concerning the estimation of preservation values for visibility protection at national parks and to extend the information available from previous studies. Basic objectives include:

- Examining how visibility protection values vary across different regions and parks. To do so, the analysis considers visibility impacts at national parks throughout the Southwest, California, and the Southeast; and values are estimated for one selected park in each region.
- Analyzing how different resource protection attitudes and behaviors are tied to WTP, and to the motive definitions economists traditionally use (option price, bequest value, existence value). This examines the validity of the separation of values into these motive categories, which is also done in the study.
- Examining the impact of respondent uncertainty in the CVM exercise upon the reported values, and examining which respondent characteristics are tied to valuation uncertainty. This is accomplished through a follow-up question on the respondents' self-perceived accuracy of their WTP responses.
- Testing for the ability to control part-whole bias related to other air pollution impacts and other national park natural resource protection issues, and correcting for any such bias. This is done through a survey design attempting to mitigate such impacts before the WTP question, paired with a follow-up question addressing the existence and significance of the problem.
- Developing direct and realistic CVM scenario context information, and testing the impact of specific changes in context information.
- Addressing the issue of what level of information must be presented about visibility protection at other potentially competing national park sites, while bidding on only one park region, by including this information in some survey versions, but not in others.
- Addressing how visibility values change with changes in the number of park regions to be protected by including a survey version that addresses values for protection in three regions at once.
- Refining select CVM design features and analysis procedures to address issues raised in the literature.

Six versions of the questionnaire were developed to address these questions. All versions included a photograph insert showing alternative visibility conditions at one or more national parks. These versions are summarized in Table 3.1-1 and discussed below.

### **3.1.1 Pilot Tests, Peer Reviews, and Pretests**

After two rounds of pilot testing, with approximately ten individuals per round, a revised instrument was prepared and sent out for peer review. The reviewers included sociologists familiar with national park visitor issues and survey design issues, economists familiar with CVM design, and an atmospheric scientist familiar with visibility issues. Based upon these reviews, the instrument was revised to a pretest draft.

Twenty in-person pretests were conducted by two professional interviewers from Colorado Market Research, a Denver survey firm. The interviewers obtained responses from twenty Denver residents in several different neighborhoods selected to represent a range of socioeconomic characteristics. The interviewers carried a display showing the same photographs and map as were used in the final questionnaire insert. Respondents were shown the display and asked to answer the questionnaire on their own. The interviewer then asked some specifically prepared follow-up questions and made note of any other comments offered by the respondents.

Overall, the pretest respondents indicated interest in the topic and in the photographs and seemed to understand the questions, including the WTP questions. The pretest results indicated that the average time to complete the questionnaire (33 minutes) was still longer than desired. A few more questions were therefore either simplified or eliminated to get the expected average completion time closer to 25 minutes. Other minor changes in the presentation were also made to further streamline and reduce the print on each page, as well as to further refine some specific wordings.

One of the pretest follow-up questions was whether the respondent felt his WTP responses were for the specific changes in visibility only, or the responses also included some value for the protection of national parks in general. The responses to this question suggested that some of the respondents were including general values. This question was, therefore, included in the final questionnaire.

### **3.1.2 Outline of the Final Baseline Questionnaire**

The baseline version (labeled Version 3 below) of the questionnaire consists of six sections, with WTP questions focusing on the national parks in the Southwest. A copy of this baseline questionnaire is included in Appendix A and includes the sections discussed below.

**Table 3.1-1**  
**Summary of Questionnaire Versions**

	Title	Photo Insert Illustrates	Focus Region for WTP	Focus Park
1.	California Parks	3 regions	California	Yosemite
2.	Southeast Parks	3 regions	Southeast	Shenandoah
3.	Southwest Parks (Baseline version)	3 regions	Southwest	Grand Canyon
4.	Multiple Regions (1 WTP for each of three region)	3 regions	California, Southeast, and Southwest	Yosemite, Shenandoah, and Grand Canyon
5.	Limited Information (reduced WTP scenario details)	3 regions	Southwest	Grand Canyon
6.	Single Region Focus (presentation for only 1 region)	1 region only	Southwest	Grand Canyon

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**Cover**

The cover provides the title "MANAGING VISIBILITY AT NATIONAL PARKS: WHAT IS YOUR OPINION?"; a pictograph with trees, mountains, a dollar sign, fish and a family to indicate a variety of competing issues facing the family and the natural environment. The cover also states, "Research conducted for the Center for Economic Analysis at the University of Colorado." The back cover states that the survey should be returned to RCG/Hagler, Bailly. These affiliations, rather than a federal agency, are listed to reduce any perceived incentives related to potential sponsor bias (Mitchell and Carson 1989). The back cover also allows space for comments, which are used in consistency checking of individual responses, and to better understand the overall responses.

**Section 1: About Your Visits to National Parks**

The first four questions in this section concern the respondent's past and expected future visitation to national parks. These questions are fairly straightforward making it relatively easy for the respondent to get started (Dillman 1978). They also get the respondent thinking about national parks in general and their own past and intended future visitation and experiences as a means to help the respondent begin to establish the substantive importance to themselves, if any, of the hypothesized visibility changes.

National park visitation is expected to be an important factor related to responses concerning the value of protecting visibility at national parks for two reasons. The first is that visiting national parks probably reflects a greater interest and concern for the protection of this sort of resource, and will therefore be one measure of differences in tastes and preferences across the sample. The second is that national park visitors will have some actual experience to draw upon in answering the questions, which may result in some differences in their responses to hypothetical questions. These hypotheses are tested in Chapter 4.

These questions also lead the respondent to view the map included in the insert, which shows most of the national parks in the country at which visibility is considered an important resource<sup>1</sup> (See below for discussion of the insert). This distinction allowed the focus to be on just those units of concern, versus all NPS units, without using the term "class I areas." This map is intended to help define the regions (Southwest, Southeast and California) used in the questions, identify the national parks in the region where visibility is an important resource, and to provide the subsequent perspective that the WTP questions are about only a portion of all the national parks that might be of interest to the respondent.

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<sup>1</sup> Section 169a of the Clean Air Act gives certain measures of visibility protection to federal class I areas where visibility is an important resource. Subsequently, regulations were promulgated (40 CFR Part 81.400; November 30, 1979) identifying these sites following NPS recommendations.

The last three questions in this section let the respondent consider the importance, if any, of reasons (or motives) people may want to visit and protect national parks. Question 5 asks respondents to rate the importance of potential reasons for visiting national parks. The list is based, in part, on results of national park visitor surveys (Ross et al. 1985) and is intended to allow some distinction between reasons related specifically to enjoying the natural environment versus other reasons people visit national parks, such as to spend time with family or to simply have a change of surroundings. Questions 6 and 7 are about the respondents' interest in protecting national parks even if they personally could never visit a national park. The purpose of these two questions is to identify the relative importance of bequest value and existence value types of motives for the preservation and management of national park resources, and to get respondents thinking about the reasons they may want national parks preserved, and protected.

The information on attitudes about national park use and protection are also useful as consistency checks on WTP responses. I.e., one would expect that those with strong use and non-use protection attitudes would be more likely to provide positive WTP. One would also expect those with higher scores for preservation, even if they could not visit the park, would assign a larger share of their WTP to bequest value and existence value motives in subsequent questions.

## **Section 2: About Pollution Issues Facing National Parks**

Question 8 asks respondents to consider several different types of potential pollution impacts to national park resources from human activities outside the parks, and whether they consider the prevention of each a low, medium, or high priority. One of the impacts listed is visibility degradation. This question is aimed at:

- Getting respondents to think about the range of potential threats to park resources before considering one threat in more detail as a means of attempting to separate visibility protection from other national resource protection issues. This again is directed to minimize part-whole bias as well as to acknowledge competing resource protection issues.
- Obtaining information about the perceived relative importance of protecting visibility versus other types of pollution impacts from human activities outside the parks.
- Introducing the impacts as being due to man-made activity, and originating from outside the parks.

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### **Section 3: About Visibility In and Around National Parks**

This section serves to introduce, through the photograph insert and text discussions and questions, the range of effects of air pollution on visibility conditions in the three study regions. The photograph insert is discussed in detail below in Section 3.2. The photographs are presented as representing events that occur with different frequencies "on days without rain or fog" (underline added). Frequencies are presented to communicate that the average condition does not occur on all days, but rather there is a distribution of different conditions. The underlined text above is also stated on the photograph insert. The pretest results indicate respondents seem to understand this caveat.

Question 9 asks what effect having visibility as in Photo B rather than as in Photo C would have on the respondent's enjoyment of a national park visit in each of the three regions. Photo B shows a somewhat less than average amount of haze for each of the park regions, while Photo C shows the average for each region. This is the visibility change considered in the first WTP scenario. This question is intended to have respondents consider the potential significance, if any, that such a change in visibility would have for them personally (and presumably for others as well) during a park visit. This is expected to be related to option price and bequest value motives and serves to get respondents thinking about how they would be affected by such a change before asking them the more difficult WTP questions. This question also provides non-dollar information about how important a change in visibility might be for the respondent in terms of his or her own park visitation, which is useful in evaluating and interpreting the WTP responses, and provides some information from each respondent about potential attitudes toward visibility protection for all three park regions as opposed to just the one region considered in the WTP section of most survey versions.

Question 10 begins to define the pollution control mechanisms, the payment vehicle, and social context of the visibility transaction to be used in the CVM questions in terms of who will pay and how. After introducing this context, it asks how willing the respondent might be to pay higher prices or taxes to support visibility protection for national park in each of the three regions. It also highlights that each region is only one of many that might be considered for additional visibility protection to again recognize the potential for competing resource protection and to reduce potential part-whole bias. This question also provides information from each respondent about attitudes toward paying for visibility protection for all three regions, unlike the specific WTP questions that focus on just one region.

### **Section 4: About Visibility at National Parks in the Southwest**

Question 11 asks that the subject consider the photographs (for Version 3) for the Grand Canyon NP, as representative of conditions at national parks throughout the Southwest, and assess the importance of (1) improving visibility and (2) preventing visibility from getting worse at national parks in the Southwest. This question brings the respondent's focus to the single region of interest for the subsequent WTP questions and provides some non-

dollar information about the respondent's attitude toward visibility protection for parks in that region. It also introduces the idea that additional expenditures might be required to prevent visibility from deteriorating as well as to obtain improvements over current conditions. Indirectly, one can also assess the applicability to visibility protection of a prospect theory (Kahneman and Tversky 1979 and 1982) tenet that preventing losses is seen as more important than obtaining gains.

### **Section 5: What is the Value of Protecting Visibility at National Parks in the Southwest**

This section establishes the context for the WTP valuation, includes the specific WTP questions, and includes follow-up questions to help in interpreting the WTP responses. Key elements in the scenario development include:

- "New air pollution laws being considered for the protection of visibility at national parks in the Southwest could mean higher prices and higher taxes throughout the country." This reinforces the vehicle and social context of the payment introduced in the prior section.
- "These questions concern only visibility at national parks in the Southwest and assume there will be no change in visibility at national parks in other regions. Other households are being asked about visibility, human health and vegetation protection in urban areas and at national parks in other regions." These comments are designed to reduce the tendency to include values for other air pollution impacts and at other locations into the visibility value responses.
- "... assume you could be sure that any change would occur next year and continue forever, ..." This is included to reduce concerns about the certainty of provision, which has been identified as a concern by Mitchell and Carson (1989), Fischhoff and Furby (1988) and others.
- "... all households now and in the future would also pay the most it is worth to them to protect visibility." This again establishes the social context of the transaction in terms of who will pay. Moreover, it is intended to partially address concerns raised by Madariaga and McConnell (1987) about bequest values (See Section 2.2). These authors indicate that, to correctly formulate WTP values related to bequest values, respondents must know the benefits and costs to future generations. However, future benefits and costs cannot be known. This comment, therefore, addresses this problem by stating that future generations will pay the most it is worth to them, implying that net benefits to others can be assumed to be unchanged.
- "... average conditions will change in and around all national parks in the Southwest..." Again, to minimize potential aggregation biases (since many policies could affect many national parks rather than just one), regional aggregate bids are obtained, then disaggregated to values for the individual parks shown in the photographs.

Three WTP questions follow this introduction. Each question asks “What is the most your household would be willing to pay every year in increased prices and taxes” for the specified change in average visibility conditions “at all national parks in the Southwest.” While monthly payments may better proxy financial decision-making for many households, annual payments are perceived by the research team to better clarify the annual financial impacts in relation to budget constraints (in order to minimize potential budget constraint bias identified by Mitchell and Carson, 1989), and are expected to have a downward effect on the valuation (see the discussion of aggregation in Section 2.2.3).

The WTP approach is selected, as opposed to a willingness to accept payment (WTA) to forgo improvements, or to incur degradation, due to the operational practicalities. WTA measures have some appeal in theory, and may be appropriate if the affected individuals have a property right to be compensated by the polluters. Where WTA measures are appropriate, they can be expected to exceed WTP measures. However, the theoretical difference is uncertain and may range from very small under specific assumptions (Randall and Stoll 1980) to very large if preferences begin to reflect a lexicographic ordering phenomenon. Operationally, WTA responses are often plagued by those who do not respond, or respond with infinity, potentially reflecting emotional or ethical rejection of the WTA premise. As a result, CVM practitioners often advise against the use of WTA measures (Mitchell and Carson 1989). Finally, any policy that reduces widespread haze impacts at national parks will likely call for control measures that are ultimately paid for by a large number of individuals, or even by all of society. Therefore, a WTP measure has an appropriate foundation in policy analysis as well.

WTP is obtained for the three hypothesized changes in average visibility conditions.

1. Obtaining improvement in average conditions from Photo C to Photo B. This is a compensating surplus value measure and is subsequently referred to as WTP1.
2. Obtaining improvement in average visibility conditions from Photo C to Photo A, which exceeds (or equals) the improvement from Photo C to Photo B. This is a compensating surplus value measure and is subsequently referred to as WTP2.
3. Preventing degradation in average visibility conditions from Photo C to Photo D. This is an equivalent surplus measure and is referred to as WTP3.

Prospect theory, and neo-classical utility theory, would suggest that for a comparable visibility change, WTP to prevent a degradation would exceed WTP to obtain an improvement, but the expected magnitude of such a difference is uncertain.

The WTP elicitation procedure in the questionnaire employs a payment card approach with no benchmarks, where respondents have the option to review a variety of potential alternative payments and choose the best response. This approach was selected to obtain greater estimation efficiency for the selected sample size, as opposed to referendum approaches (Cameron and Huppert 1988). In addition, we have found that payment cards typically obtain lower item non-response rates in mail surveys than do open ended WTP questions (see, for example, Rowe et al. 1986, Rowe et al. 1985, and Rowe and Schulze, 1987). The dollar checklist is the same for each WTP question and ranges from \$0.00 to “more than \$750.” To minimize the potential for researcher induced range bias discussed by Mitchell and Carson (1989), and Fischhoff and Furby (1988), the range of values included in the checklist was based on the pretest results.

Question 1.5 asks respondents to give any information that might help explain their answers to the WTP questions. This approach was selected over a checklist of possible explanations for zero responses because we have found that comments offered in the respondents’ own words are very helpful for interpreting the refusals, zeros, high bids, and other non-zero WTP responses, and it allows the researcher the benefit of the respondent’s own clarification on the issue and their WTP response. Respondents are also invited to give any additional comments on the back page of the questionnaire.

Question 16 recognizes the difficulty in such-WTP exercises and asks for a self assessment of the accuracy of the WTP responses. It allows respondents to indicate the overall strength of the value signal provided. Fischhoff and Furby (1988) express concern about “forcing” more out of respondents than they have to give. They suggest it may be more appropriate to screen respondents for whether they have answers to give, than for them to be forced to trust and express nascent feelings (page 169). To address the impact of any forcing induced by survey design, this question was intended to allow examination of the differences in responses between those who believe their responses are fairly accurate versus those who believe their responses are very inaccurate.

Following in the same vein, Question 17 asks respondents to consider their WTP responses and to say whether they were basically for the stated changes in visibility at national parks or whether the responses also reflected values for other needs. Based upon the pretest, there was particular concern that the WTP values may reflect a contribution to support other needs at national parks as well as visibility protection. The second part of the question asks respondents who say that other concerns are also reflected in their WTP to then estimate what percentage of their WTP responses is really for visibility. Because the early sections in the questionnaire separated visibility from other issues, and clearly indicated that the WTP responses were to be only for the stated visibility changes at national parks, this question provides information to address whether extensive scenario development can, on its own, overcome potential part-whole bias for related resource protection issues, and provides data to correct for any such bias in the value calculations.

Question 18 asks respondents to estimate what percentage of their WTP for the region they would want to allocate to the specific national park illustrated in the photographs. This reverses the order of these questions as compared to the Southwest Parklands study (Schulze et al. 1981) in which subjects were first asked a WTP for the Grand Canyon and then a WTP for the remainder of the region. The decision was made to start with WTP for the region because:

- The long range transport nature of the emissions related to many of the current visibility effects at national parks suggests that many pollution control strategies targeting visibility at national parks are likely to have regional, rather than single park, effects, and
- It is presumed that the appropriate aggregation/disaggregation approach is to start with large units all simultaneously affected by a policy package and then disaggregate to small units to obtain individual park values.

Question 19 asks respondents to give the percentage of their WTP responses that they would attribute to the following motives:

- So my household and I could enjoy conditions as natural as possible on visits to national parks in the Southwest
- So others, now and in the future, could enjoy conditions as natural as possible on visits to national parks in the Southwest
- To have conditions as natural as possible at national parks in the Southwest, even if no one were to ever visit
- Other (please specify)

These potential motives are defined to reflect option price, bequest value, and existence value as defined in Section 2.1. Some previous CVM studies (Greenley et al., 1981) have asked for separate WTP estimates for the different motives, assuming that these could be summed to obtain a total preservation value. The approach taken here presumes there is less potential for upward bias in the total value estimate, which is of most importance, and in the individual component value estimates, if the total is first obtained and then disaggregated to value components (see Section 2.2.3).

### **Section 6: About You and Your Household**

The last page of questions concerns socioeconomic characteristics of the respondent and the household that might be related to attitudes about visibility protection at national parks. These include age, sex, education level, and employment status of the respondent; and the number and age of all household members and household income.

### **3.1.3 Description of the Six Versions**

As summarized in Table 3.1-1, questionnaire Versions 1, 2, and 3 are identical except that they focus on different regions in Sections 4 and 5 (Questions 11-19) of the questionnaire. Version 1 focuses on national parks in California, as illustrated in the photo insert by Yosemite National Park. Version 2 focuses on national parks in the Southeast, as illustrated in the photo insert by Shenandoah National Park. Version 3 focuses on national parks in the Southwest, as illustrated in the photo insert by Grand Canyon National Park. The photo insert, discussed below, is identical for Versions 1 through 5. As summarized in Table 3.1-1, Versions 4, 5, and 6 reflect alternative variation of the instrument to allow for tests of the effects of specific changes in the design.

#### **Version 4: Multiple Region Focus**

There is concern in CVM exercises that values for resource protection for one site (or issue) will be different if resource protection must simultaneously be purchased at multiple sites (or for multiple issues). As a result, it may be invalid to add together values for individual policy package components, if they were estimated independently and individually, to obtain a total value for the entire policy package. I.e., one may not be able to add together values derived separately for the Southwest and California to value a policy package that obtains both. This is the aggregation problem discussed in Chapter 2.

For visibility protection at national parks, it may be the case that some policies may impact multiple regions simultaneously. To examine the potential magnitude of the aggregation problem for more than one region, Version 4 includes WTP question about visibility protection for national parks in all three regions simultaneously.

All the introductory questions and information are the same as in the baseline survey version, except that Question 11 and the WTP introduction refer to all three regions rather than just one. The introduction to the WTP questions in Version 4 reads as follows:

New air pollution controls being considered for the protection of visibility at national parks in California, the Southwest, and the Southeast could mean higher prices and higher taxes throughout the country. The next questions concern how much obtaining improvements and preventing worsening in visibility at national parks in each of these regions would be worth to your household if you had to pay for the improvements in all three regions each year.

These questions concern only visibility at national parks in California, the Southwest, and the Southeast, and assume there will be no change in visibility at national parks in other regions.... (the remainder of the introduction is unchanged).

There are three separate WTP questions, one for each region for obtaining an improvement in average visibility conditions from the current 50th to the current 75th percentile at national parks in that region. The WTP follow-up questions are the same except that the percentage for a single park is not asked, and the remaining questions refer to all three regions.

The responses to these three WTP questions can be analyzed in concert with the responses to the first WTP question in Versions 1 through 3: Question 12 in Version 4 asks for a WTP for the same change in visibility as that asked in Question 12 in Version 1; Question 13 in Version 4 asks for a WTP for the same change in visibility as that asked in Question 12 in Version 3; and Question 14 in Version 4 asks for a WTP for the same change in visibility as that asked in Question 12 in Version 2.

### **Version 5: Limited Information**

The continuing investigation into the design of CVM scenarios has tended to lead to identifying more and more transactions characteristics that may impact the valuation. For example, Mitchell and Carson (1989) have defined many potential sources of bias due to the selection or inclusion of scenario information. Similarly, Fischhoff and Furby (1988) have identified a long list of definitional attributes that may be important. These issues were discussed in Chapter 2. In fact, nearly every CVM author has added information issues of concern to the scenario design. The problem, however, arises that to meet every identified potential need may result in a deluge of detail that distracts attention from the critical features of the CVM scenario. Some attempts must be made to begin to look away from what information may have some impact, and to look to what information has the most significant impacts upon the magnitude of the estimates.

Version 5 presents one look at this issue by simply deleting most of the second paragraph in the baseline WTP scenario development, which includes several potential information needs recently identified in the literature. Specifically, Version 5 deletes the following information used in Version 3 (with identifiers (1), (2) and (3) added for reference in the subsequent discussion):

(1) Other households are being asked about visibility, human health and vegetation protection in urban areas and at national parks in other regions. (2) For these questions, assume you could be sure that any change would occur next year and continue forever, and (3) all households now and in the future would also pay the most it is worth to them to protect visibility.

Comment (1) was originally included to reduce incentives to inflate WTP to cover values for other air pollution control effects as a means of reducing part-whole bias. The effect of its deletion, if any, is expected to result in higher WTP values. Comment (2) reduced uncertainty about the provision of the good. Mitchell and Carson (1989) and Fischhoff and Furby (1988) suggest that if this is unspecified, the subject may have concerns about the

actual provision of the good. The effect of its deletion, if any, is expected to result in lower WTP values. However, we suspect the effect may be minimal as our experience is that most individuals accept the assumption of the stated change for responding to the valuation, and those who are uncertain, or do not accept the assumption, frequently state \$0 and add written comments clarifying the rejection nature of their response, which leads to their WTP response being treated as a rejection bid rather than a valid value statement for visibility changes. Comment (3) was included to better establish the social context of the transaction, and to address the bequest value formation and interpretation concerns raised by Madariaga and McConnell (1987). Omitting this information reintroduces the “individualistic altruism motive” these authors identify, and the effect, if any, is expected to increase bids.

Several of the follow-up questions can also be examined to see if the difference in the introduction has any effect. Overall, the deletion of this information could have minimal effect if the individual effects are all minimal, or if the effects are offsetting. Because we expect minimal impact of deleting the comment on certainty, but cannot be sure of these expectations, we expect the deleting of this paragraph will have a zero or positive impact upon the bids.

#### **Version 6: Single Region Focus**

As identified in Chapter 2, there is concern that CVM experiments need to identify, or even include, other similar environmental impacts that may compete for funding. The primary issue that motivates this concern is potential part-whole bias, where the respondent may inadvertently include values for related goods. Therefore, it is sometimes argued that stated values for the resource protection issue in question may be overstated, due to failure to at least consider the existence of other competing resource protection issues in the survey instrument. If many competing resource protection issues must all be identified, explained, and even bid upon in CVM experiments, it adds significant complexity and cost to the exercise, may distract the respondents from focusing upon the one resource protection issue of most concern, and may result in lower response rates. For visibility protection at national parks, an important aspect of this question is the extent to which respondents are able to isolate national parks in a single region, or a single national park, from other national parks around the country.

To begin to address this issue, Version 6 focuses on the national parks of the Southwest and does not include many of the questions, or parts of questions, in the baseline version that refer to visitation to and visibility protection at national parks in other regions. Also the photograph insert included with the Version 6 questionnaire shows only the photographs of the Grand Canyon National Park. Sections 3 and 4 are combined and all of the questions in this section refer only to national parks in the Southwest. The WTP questions and the remainder of Sections 5 and 6 are identical to Version 3.

## **3.2 PRESENTATION OF VISIBILITY CONDITIONS**

### **3.2.1 Visual Air Quality Measures and Human Perception**

Because the survey relies on photographs to convey important information about visual air quality at the national parks, it is important to consider what is known about how human subjects perceive visual air quality depicted in this way. Several studies have been conducted that have examined the factors influencing human judgements of visual air quality. Malm et al. (1980, 1981), for example, asked subjects to rate the visual air quality in a series of scenes on a 1 to 10 scale. This rating is called the Perceived Visual Air Quality (PVAQ).

The relationship between PVAQ and the importance (and hence WTP) a subject might place on obtaining better or preventing worse visual air quality has not been examined. There is no reason to assume that because a subject can perceive a difference in visual air quality that they value such a change, but it is probably safe to assume that there is no value for changes that cannot be perceived. It is probably 'also safe to assume that for any one individual, a larger change in PVAQ would be valued the same or greater than a smaller change in PVAQ. Thus, factors that are correlated with PVAQ are likely to be correlated with WTP. We can, therefore, use the results of the PVAQ studies to help minimize the introduction of extraneous factors in the presentation of alternative levels of visibility that are known to influence PVAQ judgements. We can also use the results of the PVAQ studies to identify physical parameters that may be appropriate for relating WTP based on specific photographs to objective measures of air quality that can be tied to pollution emissions.

Four findings from the PVAQ studies are particularly important for consideration in designing and analyzing WTP studies concerning visibility conditions.

1. PVAQ ratings of actual scenes are correlated with PVAQ ratings of slides taken at the same time.

This means that using photographic representations to illustrate different levels of visual air quality is not likely to introduce distortions in subjects' responses relative to how they would respond to the actual scene in person. There are, however, many remaining questions concerning the use of photographs in WTP studies for changes in visibility. Several important factors that are not known include how differences in the features of the scene used to illustrate different levels of air quality might be expected to affect WTP responses, and how color differences between on-site viewing and photographic representations might affect WTP responses.

2. PVAQ ratings are affected by the presence of clouds, snow cover, and sun angle, as well as by air quality.

These findings underscore the importance of holding factors other than air quality constant when illustrating different levels of visual air quality for evaluation by subjects.

3. When there is a dominant distant feature in the scene, and factors such as cloud cover and sun angle are held constant, PVAQ ratings are linearly related to the atmospheric transmittance between the feature and the observer. Therefore, PVAQ is, to a first approximation, proportional to the apparent contrast of the feature against the horizon sky.

Because contrast is an objective measure of visibility conditions, it is reassuring that it has been found to be so highly correlated with PVAQ judgements. This means that subjects are responding to measurable changes in air quality in some predictable fashion. Malm et al. (1981) suggest that in the presence of multiple vista elements, PVAQ will be a function of the contrast (transmittance) of each element weighted by the fractional area subtended by that element. They qualify this suggestion with the observation that subjects seem to key in on the most sensitive features of the scene when judging changes in visual air quality. For example, a foreground feature with unchanged contrast does not seem to affect PVAQ judgements when more distant features are changing.

4. PVAQ ratings are inversely, and non-linearly, related to measures of light extinction between the observer and a distant target, such that the PVAQ ratings are more sensitive to increases in pollution (i.e., decreases in light extinction) in cleaner atmospheres.

Light extinction is inversely related to visual range, which is the distance at which a large black object on the horizon is just perceptible. This means that PVAQ ratings can be expected to be positively related to visual range levels.

### **3.2.2 Selection of Photographs**

Visibility conditions at national parks in each of the regions are illustrated with a set of photographs from a park in each region selected from the National Park Service air quality monitoring network. This network includes automatic cameras at several national parks around the country that take daily photographs of the same view at set times of day. This network is managed for the National Park Service by Air Resource Specialists, Inc., in Fort Collins, Colorado.

The parks selected to represent each of the regions are those with visibility conditions typical of most parks in the region and for which photographs were available. The selected parks are well-known parks and among the most frequently visited in each region. Yosemite National Park was selected for California, Grand Canyon National Park for the Southwest, and Shenandoah National Park for the Southeast.

The decision was made to use actual photographs rather than computer generated photographs for two reasons. The first was that the availability of the extensive NPS photograph network made it possible to obtain an acceptable set of photographs for each park (showing a range of air quality conditions with minimal variation in other factors) at relatively low cost. The second reason was that using actual photographs enhances the credibility of the presentation because it is possible to say that these various conditions actually occur, as opposed to explaining that the photos presented are artificially generated representations of conditions that do occur. Using actual photographs, however, makes it impossible to maintain exact uniformity in all factors other than air quality.

The photographs used in this study were selected to show a range of visibility conditions associated with different levels of air quality, with differences such as sun angle, clouds, snow, and color avoided as much as possible. All of the selected photographs were taken at 3 o'clock in the afternoon. Slight differences in sun angle therefore occur because the photographs were all not taken on the same day of the year. Slight differences in color due to slides being processed in different batches were also difficult to avoid.

The WTP questions in this study are framed in terms of changes in average visibility conditions, but a range of visibility conditions is shown to communicate that there is a distribution of conditions, that all days are not "average," and that a change in the average really means a shift in the distribution. Due to differences in the pattern of meteorological conditions across the seasons, presentation of an annual distribution of visibility conditions due to fluctuations in air quality can be confounded by the differences in the meteorology. We therefore decided to show the typical range of conditions during the summer, when the majority of national park visitation currently occurs. Because the purpose of the presentation is to communicate the general day-to-day variability of conditions for a lay audience, rather than give a precise depiction of a year-round distribution, and because it is necessary to keep the information presentation brief, no information about visibility conditions during other times of the year is presented. In fact, median visibility conditions are typically somewhat better in the winter than in the summer, but show a similar variability between best and worst conditions at most national parks.

Slides were selected by Air Resource Specialists, Inc., to approximately represent typical 10th, 50th, 75th, and 90th percentiles of summertime visibility conditions at each park. These slides were then reproduced as printed photographs on the glossy inserts. These photographs are not exact representations of each of these percentiles, but can be expected to adequately represent the range of these percentiles in most years. This is because the film processing and photograph reproduction process always introduces some slight changes and because actual visibility conditions vary from year to year.

Table 3.2-1 gives information about each of the photographs including the view, the NPS inventory number, and values for different visibility measures.<sup>2</sup>

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<sup>2</sup> For additional technical discussion see Malm et al. (1980, 1981), EPA (1985) and Trijonis et al. (1990).

**Table 3.2-1**  
**Photographs Used to Illustrate Visibility Conditions**

Park	View	NPS Photo Inventory Number	Representative Percentile	Average Visual Range for the Percentile (km)	Single-Target Contrast	Single-Target Atmospheric Transmission	Weighted Average Atmospheric Transmission
Yosemite	Half Dome	A 65	90	150	-0.81	0.00	0.973
		B 657	75	125	-0.66	0.73	0.924
		C 114	50	90	-0.23	0.26	0.723
		D 105	10	45	-0.05	0.06	0.524
Grand Canyon	Mt. Trumbull	A 738	90	250	-0.71	0.89	0.941
		B 887	75	200	-0.72	0.90	0.945
		C 1087	50	155	-0.64	0.80	0.892
		D 1182	10	115	-0.55	0.69	0.830
Shenandoah	Rocky Mt.	A 552	90	75	-0.84	0.93	0.861
		B 1869	75	50	-0.39	0.43	0.445
		C 2297	50	25	-0.35	0.39	0.418
		D 379	10	10	-0.15	0.17	0.256

- Representative percentile is the approximate percent of time visibility is less than or equal to the represented level during the summer season.
- Visual range is the distance at which a large black object just disappears from view, or can no longer be distinguished from the background.
- Single-target atmospheric transmission is a measure of the light transmitted from a single point in the scene.
- Single-target contrast is derived from the single-target atmospheric transmission and is a measure of the difference in brightness between the target and the background.
- Weighted average atmospheric transmission is the atmospheric transmission between each scenic feature and the observer, weighted by the fractional area of the scene subtended by each feature.

None of these measures fully accounts for the different content of the scenes across the three national parks considered, and they therefore have limitations for use in comparisons across the different parks.

The approximate visual ranges typical of each percentile are given in the table. NPS (1988) reports 10th, 50th, and 90th percentile visual ranges for each of the national parks in the network based on teleradiometer, photographic densitometry, or extinction measurements. We took the averages of the 10th, 50th, and 90th percentile estimates reported for monitored summers (available data varies by park, but typically cover several years during the 1980s) at each of the three parks and interpolated to get an approximate visual range for the 75th percentile at each park.

The last three measures given in Table 3.2-1 are taken directly from the photograph insert used in the survey. NPS staff calculated these measurements using information recorded with a digitizing camera, which converts light reflected from the image into digital density values. As expected, these measures are somewhat, but not dramatically, different than the same measures for the original slides.

The single-target measures used Half Dome in the Yosemite photos, the U-shaped ridge to the right of Mount Trumbull in the Grand Canyon photos, and the near ridge to the right of the center of the image in the Shenandoah photos. Due to the target specific nature of these single-target contrast measurements, it is not appropriate to compare these across the scenes for the different parks, or to necessarily infer that the contrast at the point is representative of the entire photograph.

The weighted average atmospheric transmission measurements may be somewhat more comparable across the scenes for the different parks because they take into account each different-distance feature in the overall atmospheric transmission.

One potential problem in the photoset is that both of the atmospheric transmission measurements for the 75th and 90th percentile photographs for the Grand Canyon are virtually identical. The visual air quality in both of these photographs is quite high, but visual inspection shows that the detail of the canyon walls is more clearly delineated in the 90th percentile photograph than in the 75th percentile photograph. Atmospheric transmission is just one technical measure that can be used to characterize visual air quality, but it does not necessarily reflect all the information that the human observer sees and responds to when viewing a scene.

### **3.2.3 Layout of the Photograph Insert**

Two inserts were developed to accompany the survey instrument: the baseline insert, used with Versions 1 through 5; and the Versions 6 insert, which focused upon the Southwest and the Grand Canyon National Park. The baseline insert is a single sheet of glossy stock that measures about 16 by 17 inches and is folded three times. The Version 6 insert measures about 11 by 13.5 inches. The title pages, shown in actual size in Figures 3.2-1 and 3.2-2, state that the visibility impacts are due to air pollution on days without rain or natural fog to reinforce that the survey concerns man-made pollution impacts upon visibility. The map, which is about 17 by 8.5 inches in the baseline insert and 12 by 5.5 in the Version 6 insert, is shown reduced in Figure 3.2-3. The map shows the continental United States divided into six regions and identifies all of the national parks that are defined as Class I areas under the Clean Air Act and that NPS has identified as parks where visibility is considered an important resource (40 CFR Part 81.400).

Inside the baseline insert, four 3 by 5 inch photographs for each of three parks are positioned in vertical columns as illustrated in Figure 3.2-4. The name of the park is given at the top of each of the three columns: Yosemite, Grand Canyon, and Shenandoah. The A photos are in the top row, and these are the 90th percentile photos for each park showing the best visibility conditions. The visibility descends to the bottom row showing the 10th percentile for each park. The Version 6 insert includes just the Grand Canyon photographs as arranged in Figure 3.2-5. The captions are the same for the four photos for each park and read as follows:

- A. Visibility on about 15% of days
- B. Visibility on about 20% of days
- C. Visibility on about 40% of days
- D. Visibility on about 25% of days

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**Figure 3.2-1**  
**Insert Title Page**  
**Version 1 through 5**

# **VISIBILITY IN THE NATIONAL PARKS**

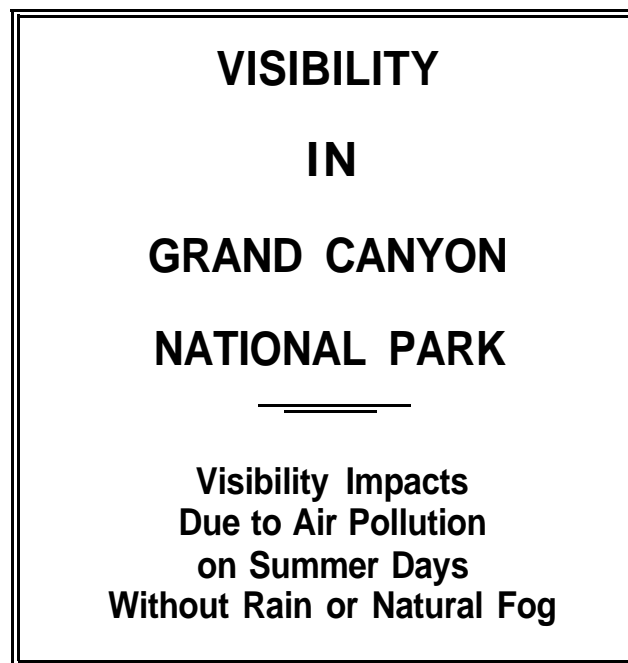
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**Visibility Impacts  
Due to Air Pollution  
on Summer Days  
Without Rain or Natural Fog**

**Photographs and Map Inside**

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**Figure 3.2-2**  
**Insert Title Page**  
**Version 6**

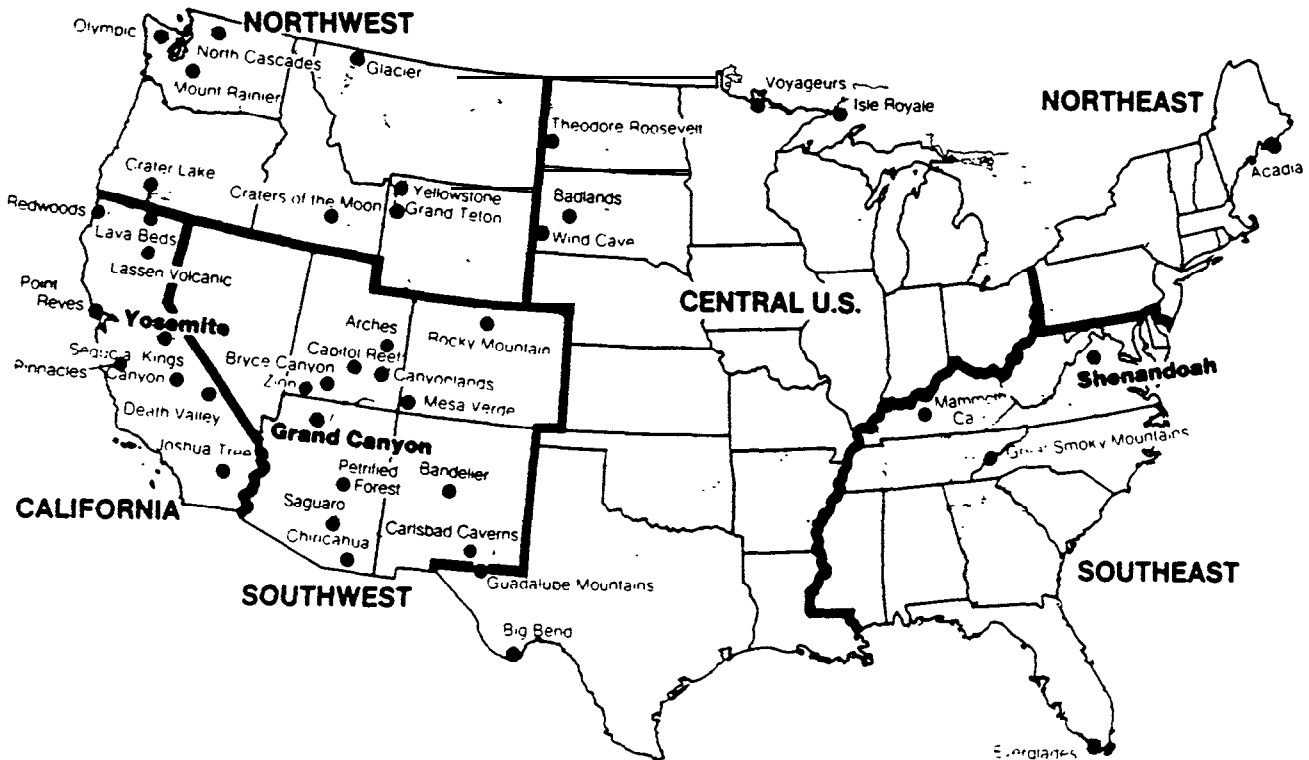


**Photographs and Map Inside**






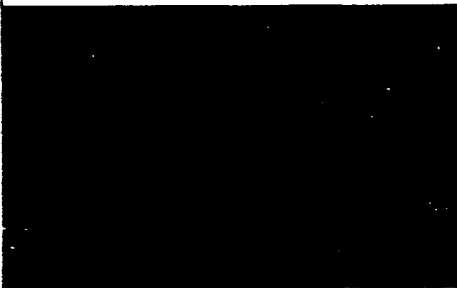

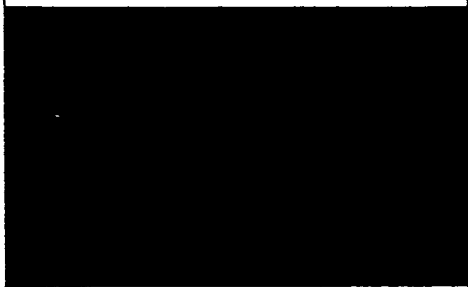




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**Figure 3.2-3**  
**Insert Map**

**NATIONAL PARKS WHERE VISIBILITY IS  
CONSIDERED AN IMPORTANT RESOURCE**

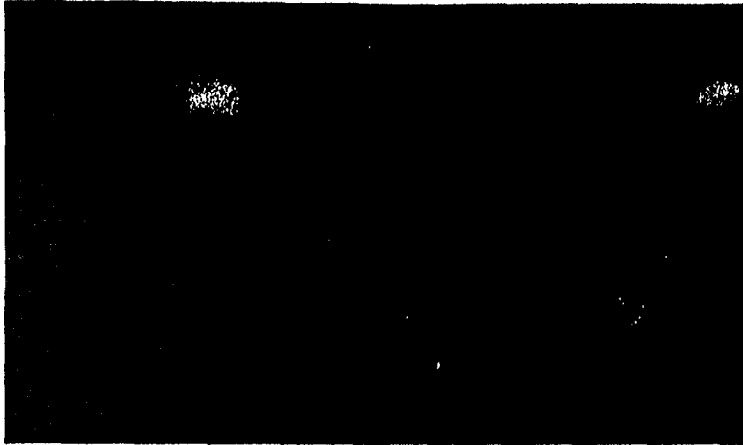


**Figure 3.2-4**  
**Insert Photograph Layout**  
**Versions 1 through 5**

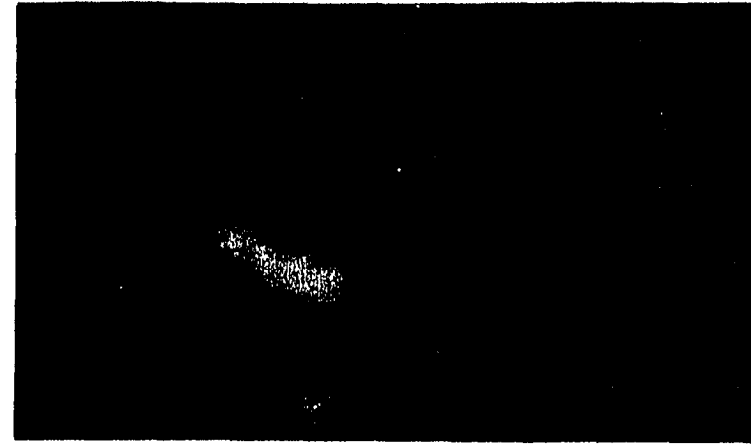
YOSEMITE	GRAND CANYON	SHENANDOAH
		
A. Visibility on about 15% of days	A. Visibility on about 15% of days	A. Visibility on about 15% of days
		
B. Visibility on about 20% of days	B. Visibility on about 20% of days	B. Visibility on about 20% of days
		
C. Visibility on about 40% of days	C. Visibility on about 40% of days	C. Visibility on about 40% of days
		
D. Visibility on about 25% of days	D. Visibility on about 25% of days	D. Visibility on about 25% of days

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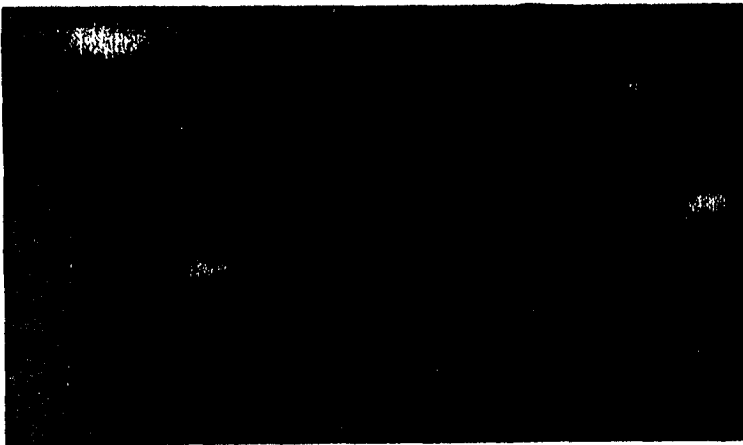
**Figure 3.2-5**  
**Insert Photograph Layout**  
**Version 6**



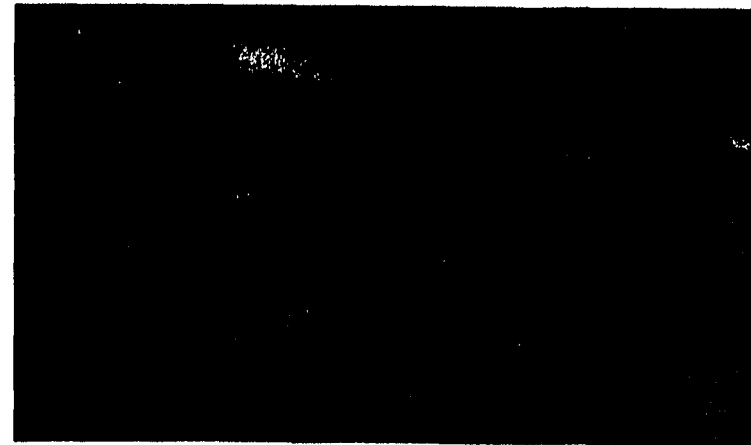
A. Visibility on about 15% of days



B. Visibility on about 20% of days



C. Visibility on about 40% of days



D. Visibility on about 25% of days

**GRAND CANYON**

These captions describe the approximate frequencies that a range of conditions represented by the photographs occur. For example, Photo A is approximately the 90th percentile photograph and is representative of conditions from the 85th to the 100th percentiles. Photo B is approximately the 75th percentile photograph and is representative of conditions from the 65th to the 85th percentiles. Photo C is approximately the 50th percentile photograph and is representative of conditions from the 25th to the 65th percentile. The Photo D is approximately the 10th percentile photograph and is representative of conditions from the 0th to the 25th percentile.

Additional information about the photographs is given in Section 3 of the questionnaire and reads as follows:

Throughout the U.S., air pollution from outside the parks causes haze that reduces how well a person can see in national parks and into scenic vistas outside park boundaries.

The enclosed photographs show different levels of air pollution at three national parks on days without rain or fog. The conditions at these parks are typical of summertime conditions at the national parks throughout the region in which each park is located.

Photograph A shows almost no haze. This occurs on about 18 summer days each year (about 15% of the time).

Photograph B shows a little haze. This occurs on about 24 summer days each year (about 20% of the time).

Photograph C shows average visibility conditions. This occurs on about 48 summer days each year (about 40% of the time).

Photograph D shows a lot of haze. This occurs on about 30 summer days each year (about 25% of the time).

### **3.3 SURVEY IMPLEMENTATION PROCEDURES**

The full study was implemented using a mailing of the final survey instrument and a telephone follow-up on non-respondents.

#### **3.3.1 Survey Mailings**

Random samples of residents of five states were selected to receive the questionnaire. The number of households from each state selected to receive each version of the questionnaire, and the response rates, are shown in Table 4.1-1. Five states were selected for the sample: Arizona, California, Missouri, New York, and Virginia. These states were selected, subject to project budget constraints, based upon a variety of considerations:

1. To include an adequate number of responses for individuals living both near and far from the national parks of interest because distance was expected to be a potentially important factor in the WTP responses (Sutherland and Walsh, 1985).
2. For each survey version, residents were sampled from the same state as the park that served to illustrate the national parks in the focus region. Home- state residents were oversampled to improve estimation accuracy for individuals with higher probability of future use. Residents in the home state are expected a priori to have a higher probability of previous and future visits compared to residents of the other four states in the sample.
3. For each survey version, residents were sampled from a state with one of the other national parks pictured on the photograph insert. In a sense, this allows for tests for “competing park” impacts.
4. For each survey version, residents were sampled from states located in regions not represented on the photograph inserts, and with relatively few prominent national parks. The two states selected in this category also represented a range of characteristics, as compared to each other and the rest of the sample, in terms of urbanization and distance from the focus parks.

The sample was selected from a list of U.S. residents maintained by Ed Burnett Consultants, Inc., Englewood, New Jersey. This list is based on sources that include the following:

- telephone books
- drivers license information
- car registration
- voters registration records
- survey information
- warranty card information
- mail order buyers information

Households from the master files were selected with an approximate equal probability of inclusion by first randomly selecting a set of zipcodes from each state (the number selected equaled the sample size and any zipcode could be sampled repeatedly), then randomly selecting a household from each zipcode. This approach was selected as the number of addresses per zipcode are targeted by the postal service to be roughly equal.

The questionnaire mailings followed a modified Dillman (1978) approach with an advance letter and three follow-up mailings. Copies of the letter or postcard sent with each mailing are include in Appendix B. The schedule of these mailings was as follows.

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August 23, 1988: Introduction letter

September 6, 1988: First questionnaire copy

September 13, 1988: Reminder postcard

September 28, 1988: Second questionnaire copy

November 3, 1988: Third questionnaire copy

Figure 3.3-1 shows the responses received each week following the mailing of the first questionnaire copy. Subjects were removed from the mailing list as their responses were received.

### **3.3.2 Telephone Follow-up**

A sample of non-respondents was selected from each of the five states for a telephone follow-up in January 1989. This sample was taken from households originally sent Versions 2 (Southeast national parks) or 3 (Southwest national parks) of the questionnaire. Telephone directories were used to obtain telephone numbers for selected non-respondents. CIC Research of San Diego, California, randomly selected among the non-respondents until 300 names and numbers were obtained, and conducted the telephone interviews. The purpose of the telephone follow-up was to determine the rate of remaining bad addresses in the original sample, and to examine the likely sign and significance of any potential non-response bias.

A copy of the questions for the Grand Canyon version of the telephone follow-up is included in the Appendix. The first three questions concerned past and potential future visitation to national parks in the Southwest (or Southeast). All of the telephone respondents were asked if they thought it was "not at all important," "somewhat important," or "extremely important," to prevent visibility from getting worse at national parks in the Southwest (or the Southeast). They were also asked the same question about obtaining potential improvements in visibility.

Telephone respondents were asked if they still had the photograph insert that was sent with the questionnaire and, if so, a few specific WTP questions were asked. However, only four could quickly locate it. Telephone respondents who no longer had the photograph insert were asked whether they would be willing to pay anything in additional prices or taxes to (1) prevent visibility from getting worse at national parks in the Southwest (or Southeast), and (2) obtain improvement in visibility at national parks in the Southwest (or Southeast). Six questions about the respondent and the household were then asked to compare the sample characteristics to the mail respondents.

**Figure 3.3-1**  
**Responses Received Each Week**

